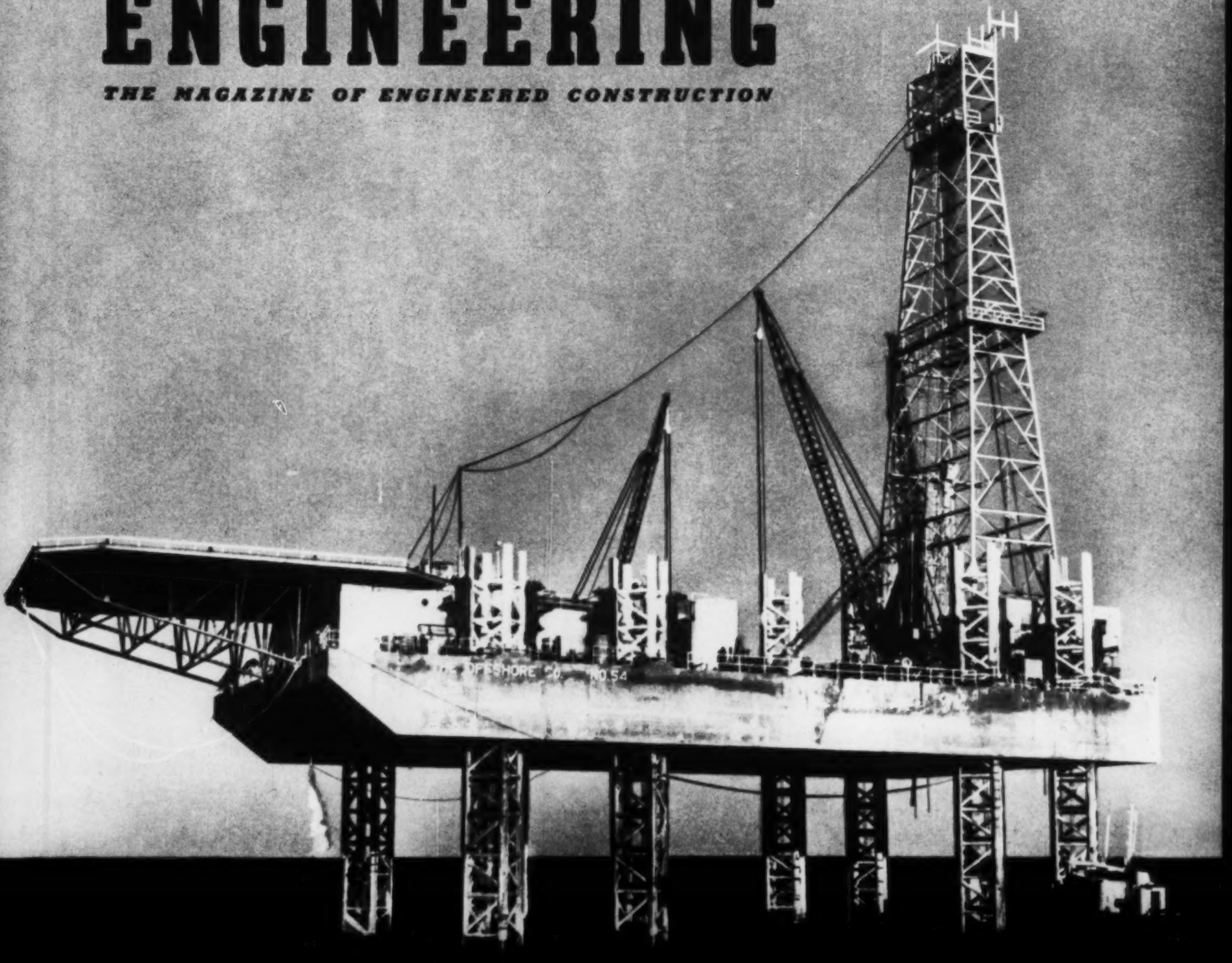
CIVIL ENGINEERING

SEPTEMBER 1958

THE MAGAZINE OF ENGINEERED CONSTRUCTION



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PIPELINE FOR NATURAL GAS STARTS HERE. See article by Ivey.

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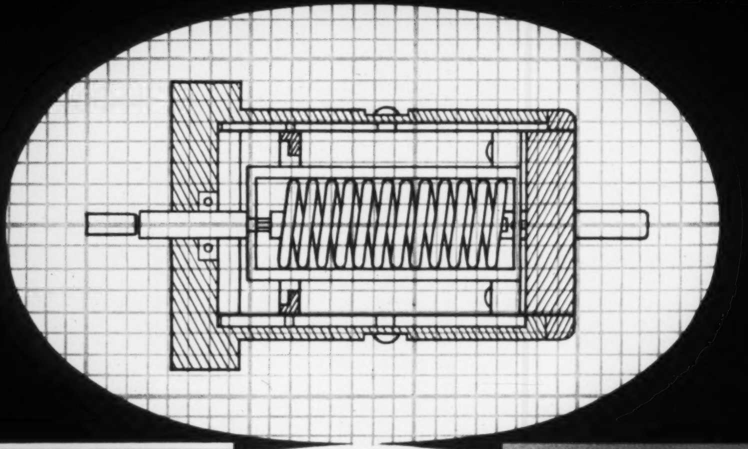

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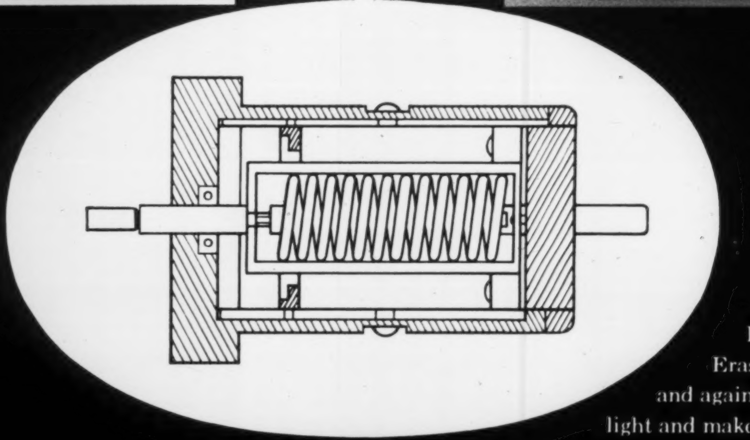

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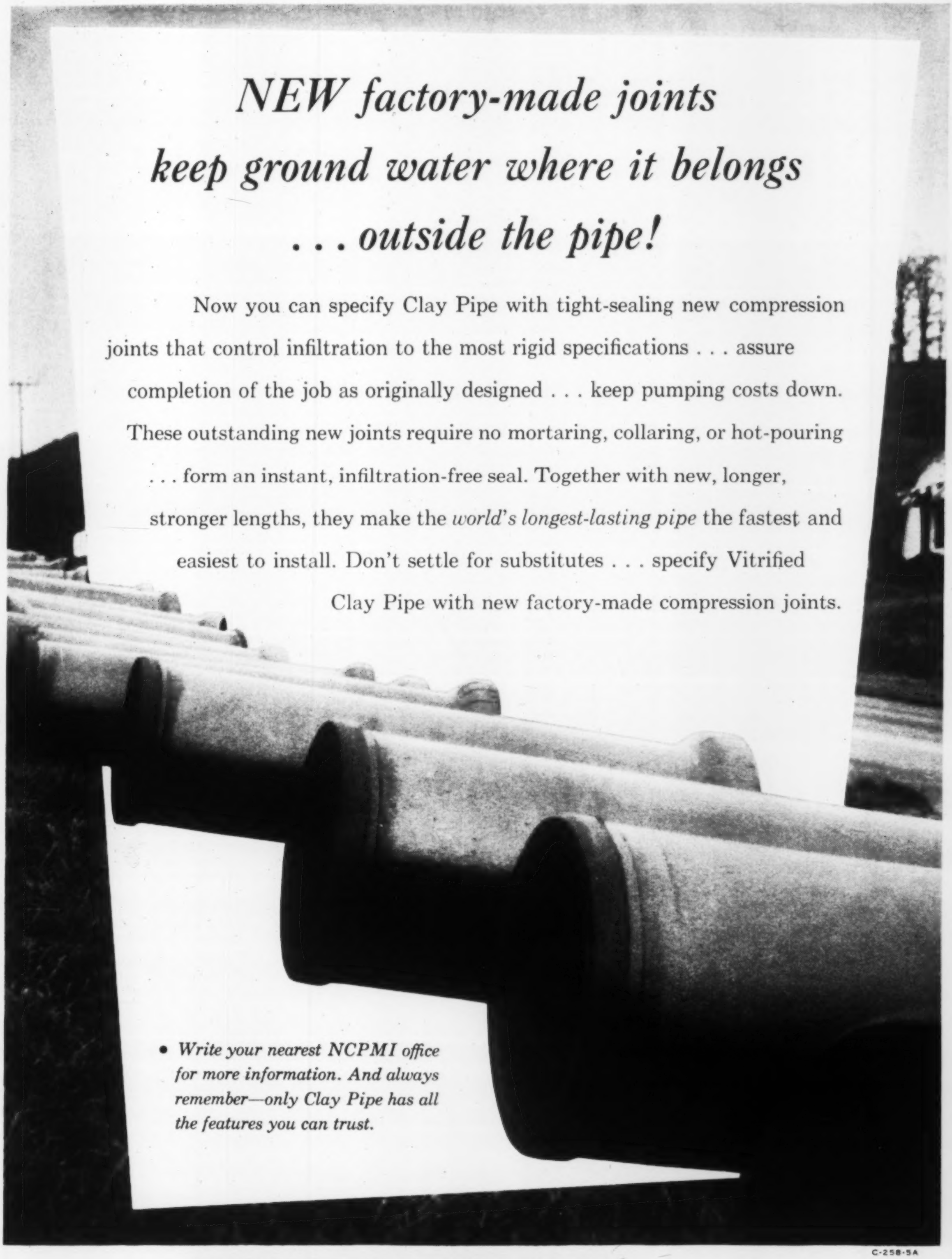

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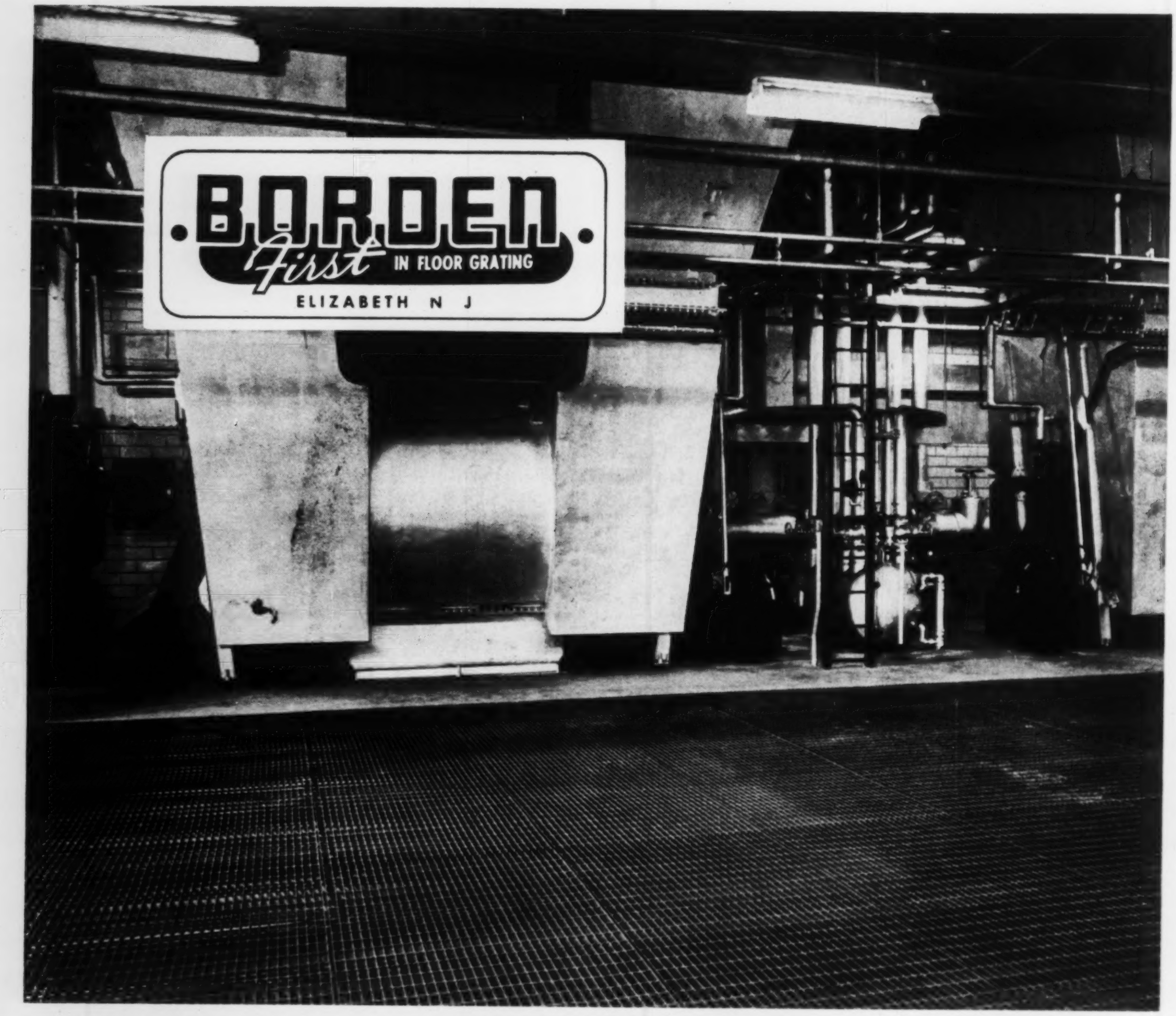

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THE MAGAZINE OF ENGINEERED CONSTRUCTION

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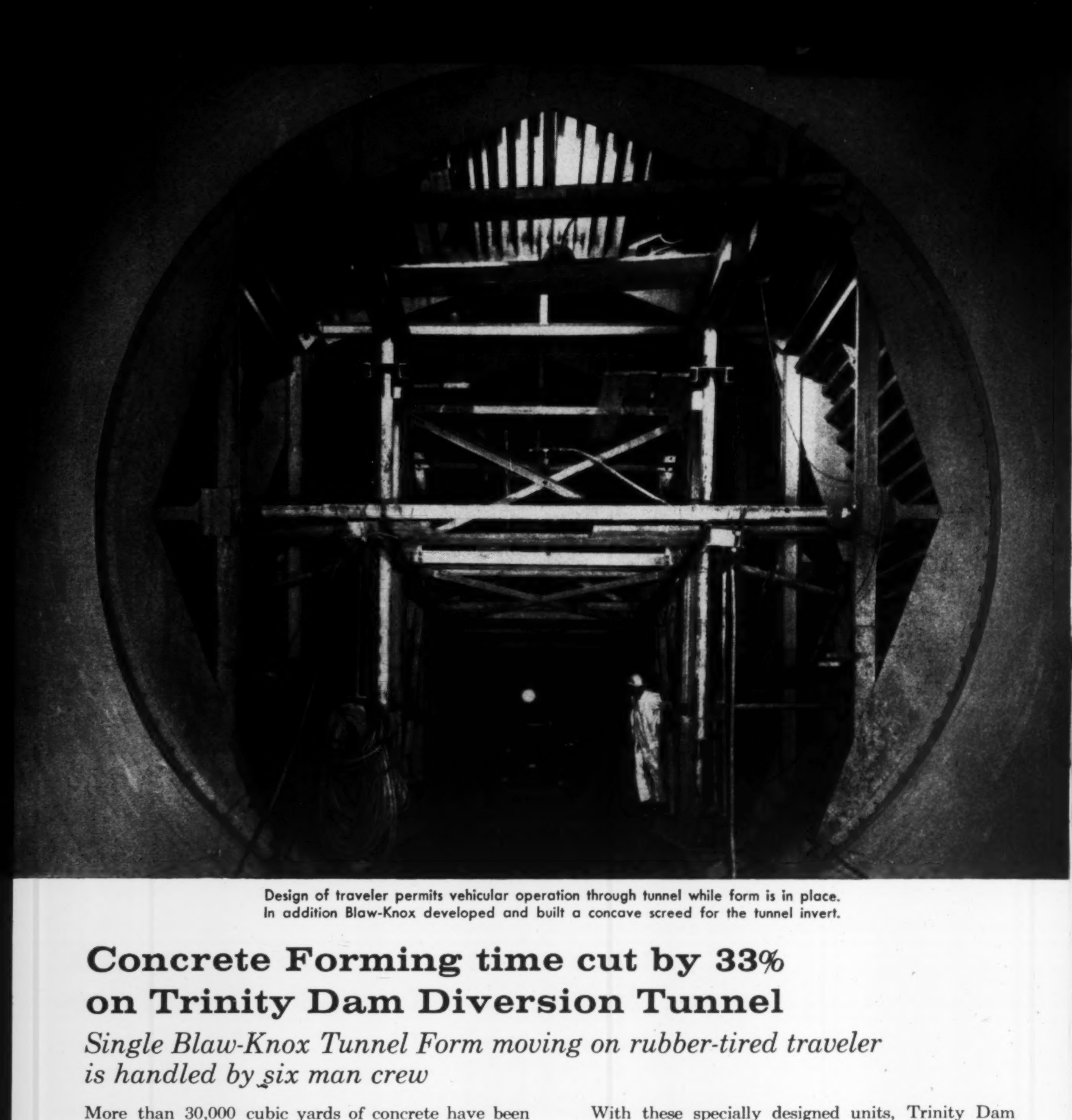

Design of traveler permits vehicular operation through tunnel while form is in place.
In addition Blaw-Knox developed and built a concave screed for the tunnel invert.

Concrete Forming time cut by 33% on Trinity Dam Diversion Tunnel

Single Blaw-Knox Tunnel Form moving on rubber-tired traveler is handled by six man crew

More than 30,000 cubic yards of concrete have been poured in the construction of the 2,570 foot long, 28-foot diameter diversion tunnel at the Trinity Dam Project at Lewiston, California. To speed forming operations, Trinity Dam Contractors chose two specially designed Blaw-Knox Tunnel Forms, each 50 feet long, equipped with two rubber-tired travelers each.

The Blaw-Knox Forms can be set, stripped, and reset without disassembling any of its components. Each set of wheels is equipped with a ratchet device to permit steering of the traveler around horizontal curves. Despite its weight, the form is moved by two men operating hand winches. Elevation is controlled by a series of hydraulic jacks, and sidewall adjustments are made with steamboat ratchets. Telescoping pipe spreaders support sidewalls during pouring.

With these specially designed units, Trinity Dam Contractors poured every day, alternating between forms, allowing 16 hours set-up time. Using other methods, a maximum of only two pours a week would be possible. Guy F. Atkinson Company is sponsor of the $49,000,000 joint venture. Other joint venturers are: M. J. Bevanda Co., Inc., Chas L. Harney, Inc., Ostrander Construction Company, A. Teichert & Son, Inc. and Trepte Construction Co.

You can put the know-how of Blaw-Knox Steel Forms Engineers to work on your concreting problems. You'll get the benefit of 40 years experience translated into versatile, rugged equipment designed to help increase your profits. Call on the Blaw-Knox Steel Forms Consultation Service for planning help now. There's no obligation, of course.

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MORETRENCH WELLPOINTS SPEED CONSTRUCTION, CUT COSTS ON DEEP LOOPING PIT ON LAKE MICHIGAN'S SHORE...

Owner: Inland Steel Company, Indiana Harbor Works, East Chicago, Indiana
Pumping Contractor: American Dewatering Corporation, Chicago, Ill.

Predrainage by Moretrench Wellpoints permitted an open cut excavation to be made to grade 48′ below lake level, eliminating the necessity for a steel cofferdam, speeding up construction of a deep looping pit for Inland Steel Company's new mill in Indiana Harbor, Ind.

Soil conditions were unusual: Stratified sand on top of original lake bottom with clay at and above subgrade — the entire area surrounded by very pervious slag fill.

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The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

Problem: *Locate—perfectly—6000 bridge anchor bolts*

Solution: *Try a little magnetism—plus "a really fine instrument"*

Scene: High-level approaches to a giant among structures—the Walt Whitman Bridge, joining So. Philadelphia, Pa., and Gloucester City, N.J.

Task: Place 6000 anchor bolts for 1500 shoes—perfectly—by drilling in place after concreting.

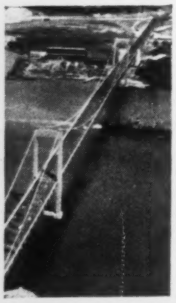
Complication: Beams were fanned in almost all spans and relatively few of the shoes were at right angles to bearing lines.

Surveyor: William D. Kirk, Jr., Union Building & Construction Corp., Passaic, N.J.

Equipment: Transit, sheet metal templates, two pocket-clip magnets, black paint and "the best crew you could ever want."

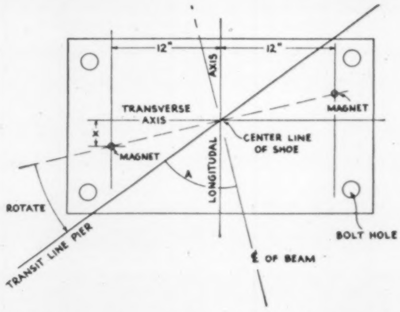
Let Bill Kirk tell it...

"The sketch shows a typical sheet metal template with pencil magnets on two lines scribed parallel to the longitudinal axis 12″ from the template center. The magnets are set at the correct distance from the transverse axis of the template, for the particular angle (A) this beam makes with the pier. This distance (X) is taken directly from the natural tables. The template with magnets affixed is rotated about the previously located centerline of shoe until the line produced by the magnets is superimposed upon the transit line. Because of the constantly changing angle, the simplicity of sliding the magnets to each new distance soon proved itself.



Walt Whitman Bridge: Length, including approaches: 6.2 mi. Roadway width: 79 ft. Span midpoint: 150 ft. above mean high water. Towers: 378 ft. high.

Bill Kirk depends on a Gurley level. It has given excellent service for years.



This ingenious template solved locating problem.

"The punched bolt holes in the template, the major axes and the corners were then sprayed with black paint; lines were scribed through it onto the concrete at the axes to give permanent alignment for the bolt-setting templates of $\frac{1}{4}$-inch plywood. With upwards of 144 bolt holes to drill on top of an individual pier it sometimes looked like a polka dot madhouse."

Kirk's idea cut eight weeks off his schedule.

Says Bill Kirk: "Venerable as our Gurley instrument is, we found that it needed only very occasional adjustment in the field, even with the beating it took while traveling in a pickup truck over rough fills. For precision, give me a Gurley—a really fine instrument."

Accuracy is nothing new at Gurley. This background of accuracy goes back to 1845. Our current Research and Development program has brought to the American surveying instrument such improvements as the Optical Plummet Transit and Variable Power Eyepiece.

The Optical Plummet Transit (Model OP-57) has proved to be such an important time-and-money saver that this feature has also been added to the Model 132 Standard Precise Transit. The new model is known as the OP-137. Both OP transits save time and trouble in setting over a point...eliminate sway of cord and plummet...are especially accurate on windy locations. The OP's are furnished with tripods which have built-in shifting heads. *(Ask for Bulletin OP-100)*

Variable Power, now standard on all Gurley transits and levels, permits wide range of magnification with *one* eyepiece...makes possible a change of magnification to suit weather and light conditions. *(Write for "Facts on VP")*

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In Minnesota

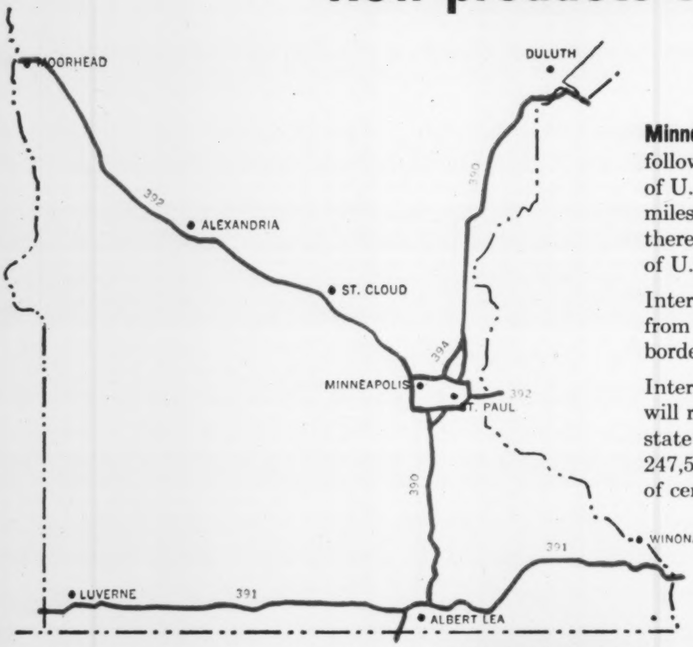
the Interstate Highway Program is moving right along

With 29.1 miles of 4-lane divided highways including 38 bridges at present under contract, Minnesota's program of 896 miles of Interstate-Defense Highways is steadily progressing.

Already well ahead of the national average of Interstate Highways under contract, Minnesota expects to have road and bridge projects totalling over $164 million under contract by 1960. These jobs will include 198 miles of Interstate Highway and 206 bridges. The program is under the direction of L. P. Zimmerman, Commissioner of Highways, and J. H. Swanberg, Chief Engineer.

KEEP OUR
ROADS
ON THE GO
USS

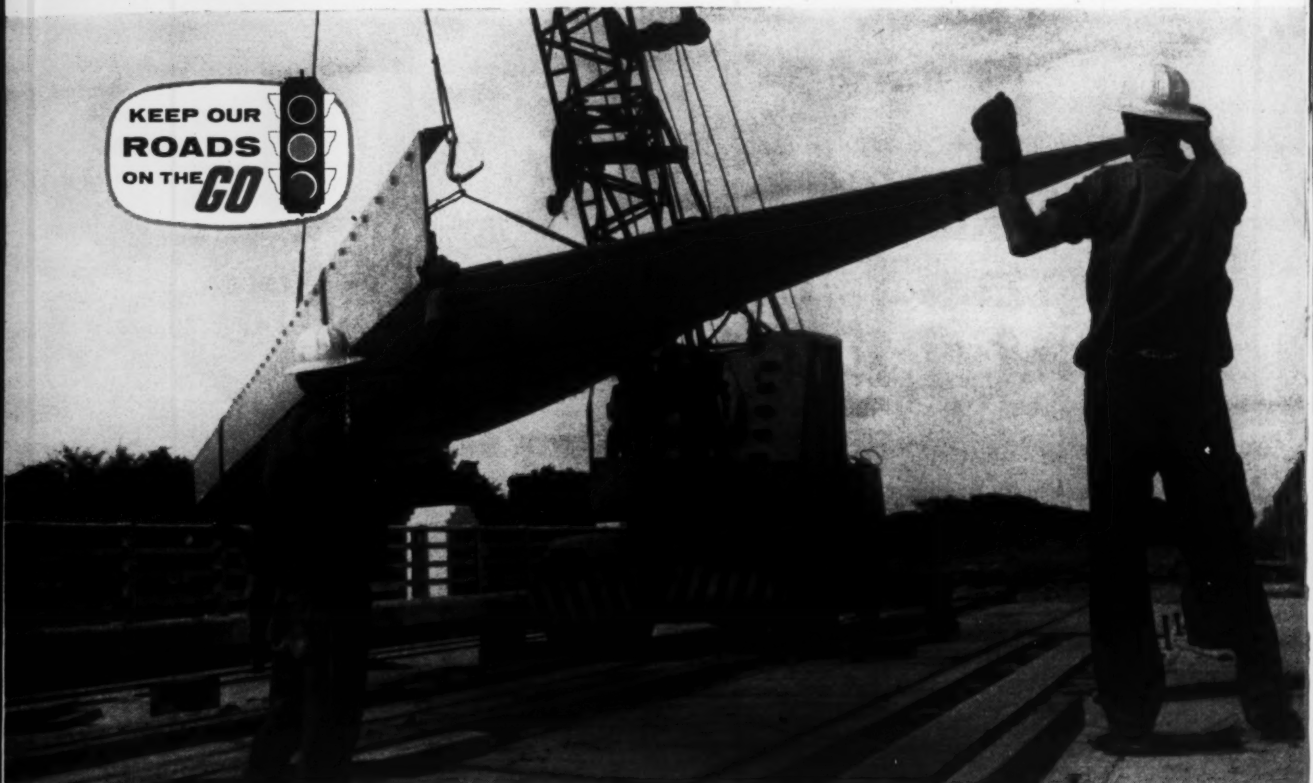
How products of United States Steel



Minnesota's $728-million Interstate program includes the following routes: Interstate Route 390, a relocation of U. S. Highway 61, from Duluth approximately 150 miles southwest to St. Paul—Minneapolis, and from there 100 miles south to the Iowa border—relocation of U. S. 65 and U. S. 69.

Interstate Route 392, running 240 miles northwest from St. Paul—Minneapolis to the North Dakota border—relocation of U. S. 52.

Interstate Route 391, relocation of U. S. 16, which will run approximately 330 miles east-west across the state from Wisconsin to South Dakota. An estimated 247,500 tons of steel and more than a million barrels of cement will be required for this construction.

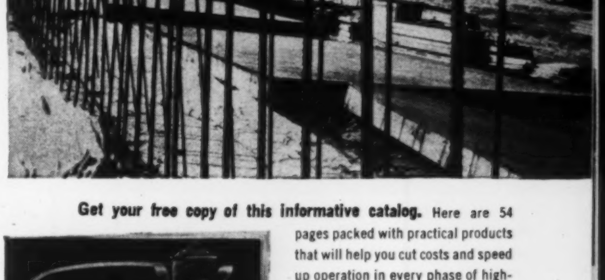

KEEP OUR ROADS ON THE GO

Steel speeds up construction on Interstate 391. This year alone, Minnesota will require some 11,000 tons of steel for structural purposes, along with 6,000 tons for concrete reinforcement. Bridges of any size and type can be built lighter, stronger and more durable—and at lower cost—with USS *Tri-Ten* Steel and with our other USS High Strength Steels, USS *Cor-Ten* and USS *Man-Ten*, as well as with USS "*T-1*" Constructional Alloy Steel. USS *AmBridge I-Beam-Lok* Flooring, open or concrete filled, can be used to keep weight and maintenance to a minimum. USS *American Super-Tens* Stress Relieved Strand and Wire are also available. Sturdy bridge railing of USS Special Steel Sections will ensure the utmost in safety and long life.

keep Minnesota's expressways on the go!

Pier foundation on Minnesota River Crossing, Interstate 390. Here, as in the six other bridges on this relocation of U. S. Route 65, steel expedites the foundation work and ensures permanence of construction. For cofferdam construction, USS Steel Sheet Piling provides easy installation of strong earth and watertight excavations. In pier and abutment foundations, USS H-Beam Bearing Piles provide a range of sizes accommodating all desired design loads with rugged, compact shape capable of being driven through difficult soils to desired penetrations. Both are finished products ready for use as shipped; installation is practically independent of weather conditions.

Preparing subgrade on Interstate 391. 1,300,000 cu. yds. of earth have already been moved on this construction which will be completed by August 1959. To meet the time and cost limits set for the Interstate Highway program, the fast-moving, big-capacity equipment used on the job requires the utmost in strength and durability. Shovels, scrapers, dozers and trucks can work at top efficiency, day after day, with the least time out for maintenance and repairs when vital parts that bear the brunt of high-speed operation are built with USS High Strength Steels or USS "*T-1*" Constructional Alloy Steel.



More than a million pounds of steel and 6,000 cu. yds. of air-entraining concrete will be used in the bridges and overpasses on Interstate Route 390. When used for such structures and for paving, *Atlas Duraplastic*, an air-entraining portland cement, provides a concrete mix that is extremely workable, more plastic and more cohesive. Fortified against freezing-thawing weather, it places, spreads and finishes easily. Reinforcement with USS *Di-Lok* Bars that feature a continuous diamond-locking deformation assures positive anchorage, reduces cracking to a minimum and makes shorter splicing possible. There is no better way to obtain concrete construction that combines permanence with low cost.

In concrete roadways, reinforcement with *American* Welded Wire Fabric makes it possible to construct concrete slabs 50 to 100 feet long with 30% greater strength and provides a longer-lasting, smoother-riding pavement.

USS and trade names in italics are registered by U. S. Steel

USS United States Steel

Divisions of United States Steel serving the highway market: American Bridge Division, Pittsburgh, Pa. • American Steel & Wire Division and Cyclone Fence Department, Cleveland, Ohio • Columbia-Geneva Steel Division, San Francisco, Calif. • Consolidated Western Steel Division, Los Angeles, Calif. • National Tube Division, Pittsburgh, Pa. • Tennessee Coal & Iron Division, Fairfield, Alabama • Universal Atlas Cement Division, New York • United States Steel Supply Division, Steel Service Centers, Chicago, Illinois.

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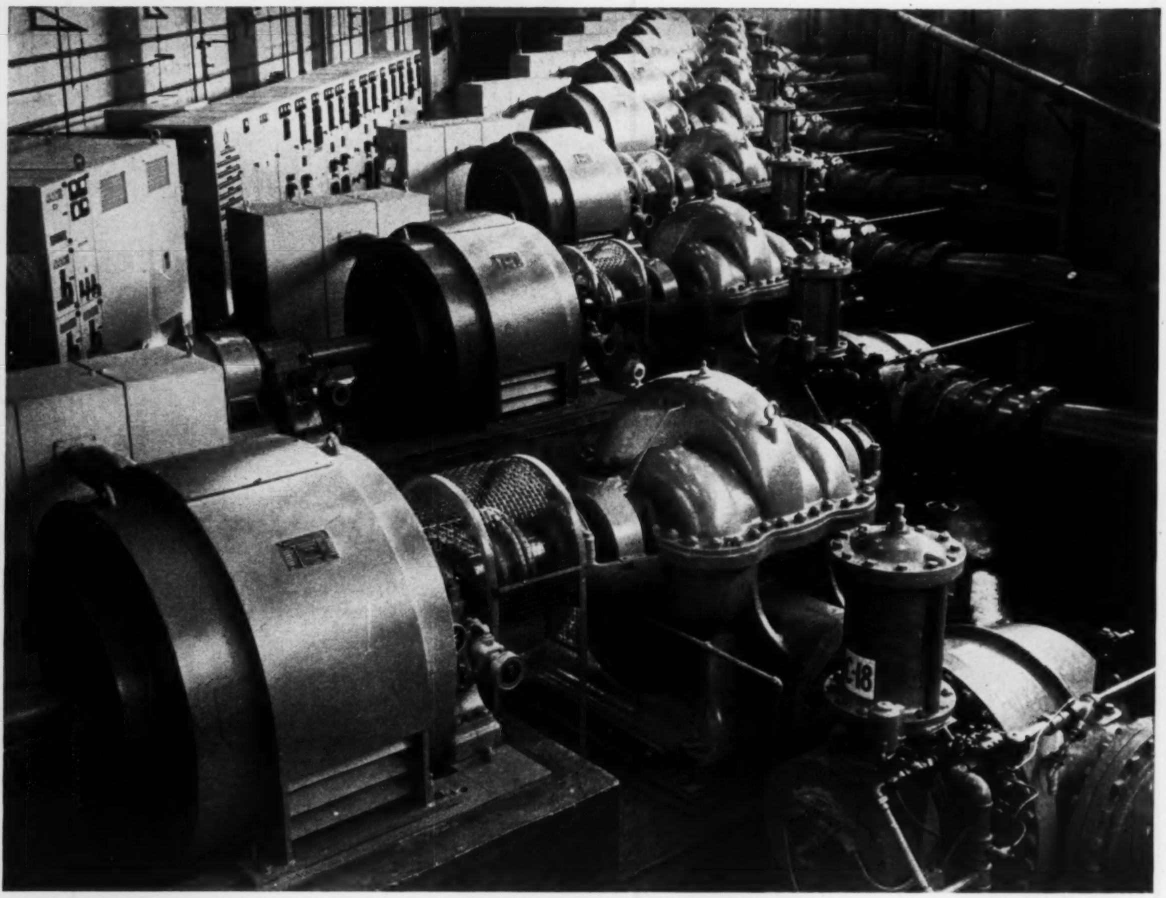
Get your free copy of this informative catalog. Here are 54 pages packed with practical products that will help you cut costs and speed up operation in every phase of highway construction. It lists all the products and the many services available through United States Steel. Just write to United States Steel Corporation, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.



Eight 24" SMS-Rotovalves are used for pump check service at the Secondary Pumping Station of the U. S. Air Force's Arnold Engineering Development Center in Tullahoma, Tenn.* Installed on 25,000 GPM pumping units, each hydraulically-operated Rotovalve has independent timing control for opening and closing, and a by-pass fast closure device for shut down in the event of power failure. Four more 24" Rotovalves perform similar service at the Primary Pumping Station.

CLOSE CONTROL OF TIMING MAKES SMS-ROTOVALVES CHOICE AT TULLAHOMA

When laying out the cooling water facilities at Tullahoma, Robert and Company Associates of Atlanta, Consulting Engineers under contract with the Tullahoma District, Corps of Engineers, U. S. Army, selected SMS-Rotovalves for pump check service. Close, positive control of valve opening and closing time that minimizes water hammer as pumps are cut in and out of the system made Rotovalves the first choice. Their rugged design and record for low maintenance cost were also important for this severe service.

SMS-Rotovalves' full-line opening offers no more resistance than straight pipe of the same diameter, means less head loss and lower pumping costs. Maximum initial shut-off, with retarded area reduction at the closing end of the stroke, controls water hammer. Opening and closing can be as fast as one second, or as slow as needed. Closure is drop tight, and monel-to-monel seats are self-purging.

You can obtain full information on SMS-Rotovalves, Ball Valves or Butterfly Valves by contacting our nearest representative. Or, write to S. Morgan Smith Co., York, Penna.

*Under construction by the Corps of Engineers, U. S. Army.

SMS S. MORGAN SMITH **HYDRODYNAMICS**

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

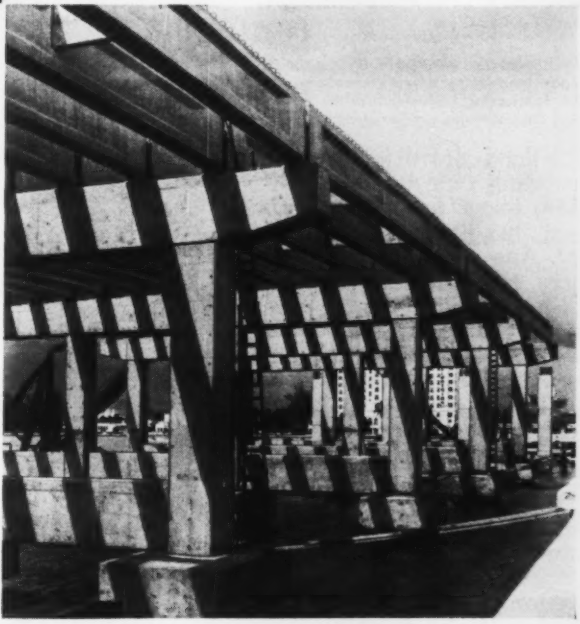
5

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

PRESTRESSED CONCRETE

CHOSEN FOR MIAMI'S NEW MacARTHUR CAUSEWAY

About 32,000 vehicles will use this bridge daily. Two fifths of a mile long and 86′ wide, it contains 536 beams 65′ and 45′ long, and 35,315 feet of 20″ x 20″ prestressed piling.



- With Florida's astounding growth of recent years, an old structure linking Miami with Miami Beach had, with its drawbridge span, become annoyingly inadequate.

To replace it, the Florida State Road Department chose a fixed span bridge of prestressed concrete. *The ease of construction, low initial and maintenance costs, and sleek modern appearance of prestressed concrete* were the deciding factors.

In the manufacture of the prestressed beams and piling, R. H. Wright & Son used Lehigh Early Strength Cement for maximum production efficiency. The units were completed quickly, ready for trucking to the job site as needed.

This is another example of the use of Lehigh Early Strength Cement in modern concrete construction.

Owner: Florida State Road Department
Contractor: Heavy Constructors, Inc., Miami and Ft. Lauderdale, Fla.
Prestressed Units Manufactured By: R. H. Wright & Son, Ft. Lauderdale, Fla.

LEHIGH PORTLAND CEMENT CO.
Allentown, Pa.

A SURE-FIRE SUCCESS FORMULA!

The Cunningham Construction Company is proud of its reputation for high-production earth moving. Says Don Cunningham: "The combination of Allis-Chalmers' productive machines and a first-rate operating crew, teamed with the excellent service our dealer provides, amounts to *an unbeatable formula for sure profits in this industry.*"

The equipment spread includes four Allis-Chalmers motor scrapers—two TS-360's and two TS-260's—plus five turbocharged HD-21 crawler tractors. Two of the tractors are used as pushers, one as a dozer. Another HD-21 tows a four-gang sheepsfoot roller and the fifth pulls an 18-yd scraper. An Allis-Chalmers FORTY FIVE motor grader levels fill, keeps haul routes smooth for high-speed scraper cycles.

Big 120-horsepower FORTY FIVE motor grader blades fill at dam site, keeps pace with fast-moving equipment like the 20-yard TS-360 motor scraper at right.

The flood control job consists of building two dams and diversion dikes, moving an estimated 325,000 cu yd in the Dona Ana area north of Las Cruces, New Mexico. Working a 54-hour week, the 10-man crew moved nearly 200,000 yd in the first 4½ weeks. This impressive volume brought construction people from all over Texas and New Mexico to see the spread in action.

Don Cunningham, veteran of more than 30 years in earth moving, points out that such performance is a powerful factor in bringing in more construction jobs.

They cut a flood control job

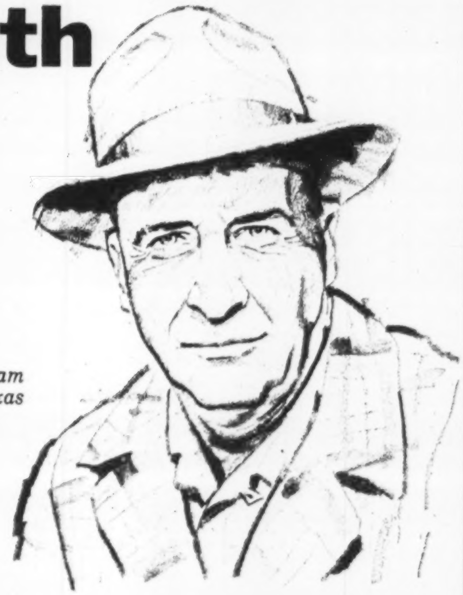
with Allis-Chalmers construction machinery!

Don Cunningham Construction Co.—with a crack crew and a fleet of Allis-Chalmers construction machines—have set an outstanding record on a New Mexico soil conservation job. They completed a flood control project scheduled for 180 days in 75! It involved 325,000 yd of earth fill.

Don Cunningham gives major credit to his Allis-Chalmers fleet—motor scrapers, crawler tractors and motor grader. He's convinced that top machine availability and extreme ease of handling are the big reasons why men and equipment were able to maintain the record pace. Cunningham estimates profit on this contract will be 20 percent greater than figured in the original bid—a hefty bonus on any job!

Look ahead...*move ahead*...and stay ahead

6-month to 2½



Don Cunningham
El Paso, Texas

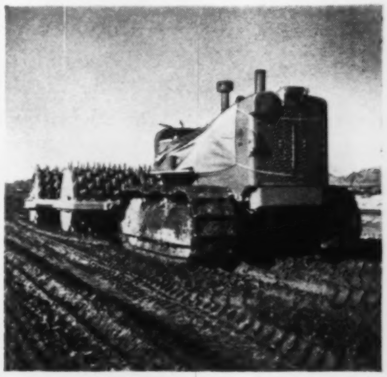
Four Allis-Chalmers motor scrapers, push-loaded by 225-horsepower turbocharged, torque converter-equipped HD-21's, moved nearly a quarter of a million yards the first month, helped boost profits 20 percent for the whole job.

with ALLIS-CHALMERS

PREVENTIVE MAINTENANCE PAYS OFF AGAIN!

Chief mechanic, "Snuffy" Oliver, and his assistant have an effective preventive maintenance program, including daily inspection of tracks, fan belts, blowers, turbochargers, cables, clutches.

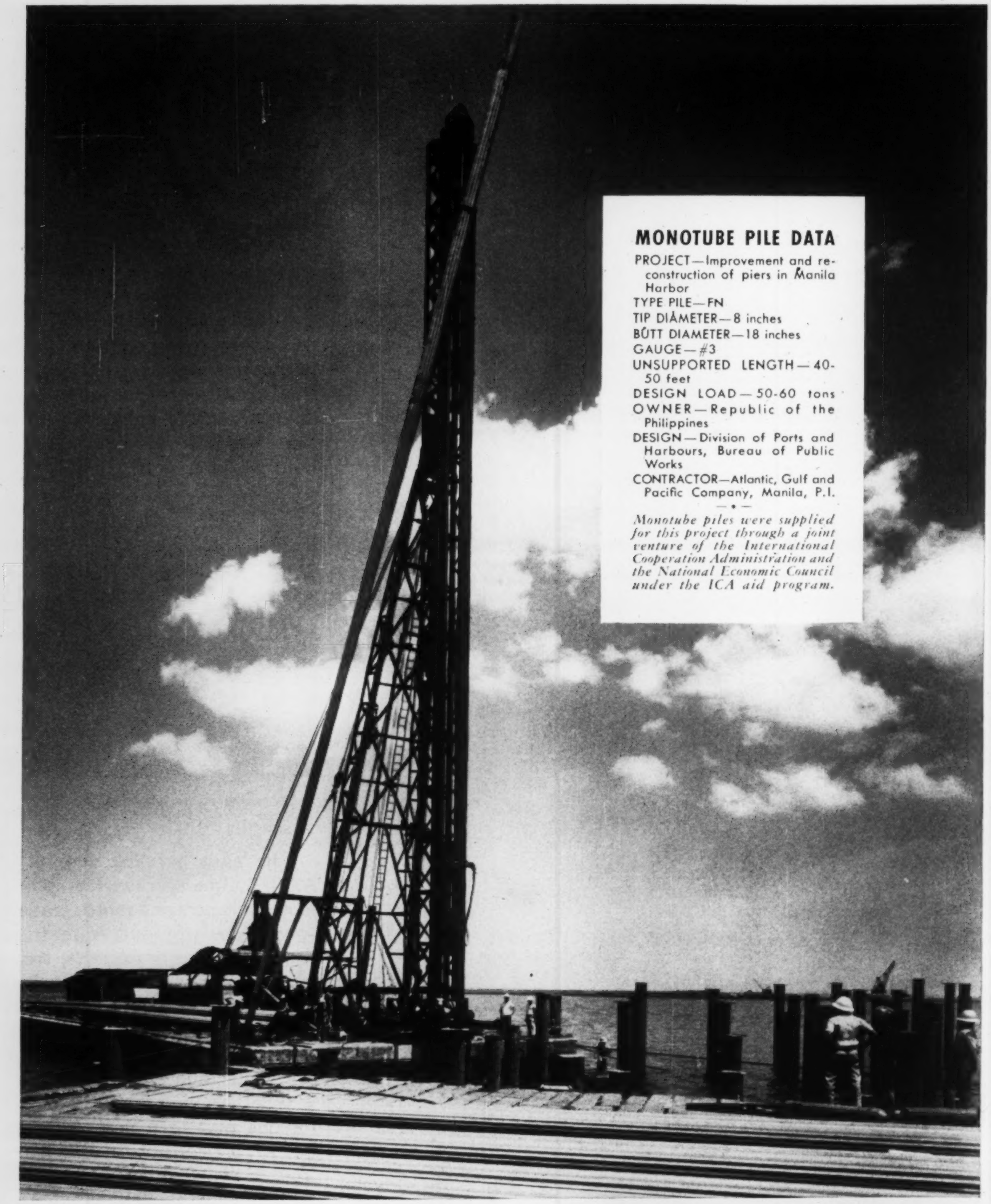
This regular maintenance keeps Cunningham's Allis-Chalmers fleet in first-class condition. Daily lubrication, servicing and inspection requires about 20 minutes a day for each machine. No other time was lost during the nine-hour working shift.



Compacting scraper-hauled fill, big HD-21 crawler tractor tows four-gang sheepsfoot roller.

The easy-service design of Allis-Chalmers crawler tractors, motor scrapers and motor graders speeds the preventive maintenance routine. For example, truck wheels, idlers and support rollers need lubrication only once every 1,000 operating hours. Timesaving convenience like this keeps every machine ready for action.

Whether your operations call for one unit or a fleet, you can get high production like this. Your Allis-Chalmers dealer will recommend the right equipment for your jobs—from a complete line of up-to-the-minute construction machinery. See him now and ask for a demonstration on your job. Allis-Chalmers, Construction Machinery Division, Milwaukee, Wisconsin.



MONOTUBE PILE DATA

PROJECT—Improvement and reconstruction of piers in Manila Harbor
TYPE PILE—FN
TIP DIAMETER—8 inches
BUTT DIAMETER—18 inches
GAUGE—#3
UNSUPPORTED LENGTH—40-50 feet
DESIGN LOAD—50-60 tons
OWNER—Republic of the Philippines
DESIGN—Division of Ports and Harbours, Bureau of Public Works
CONTRACTOR—Atlantic, Gulf and Pacific Company, Manila, P.I.

—•—

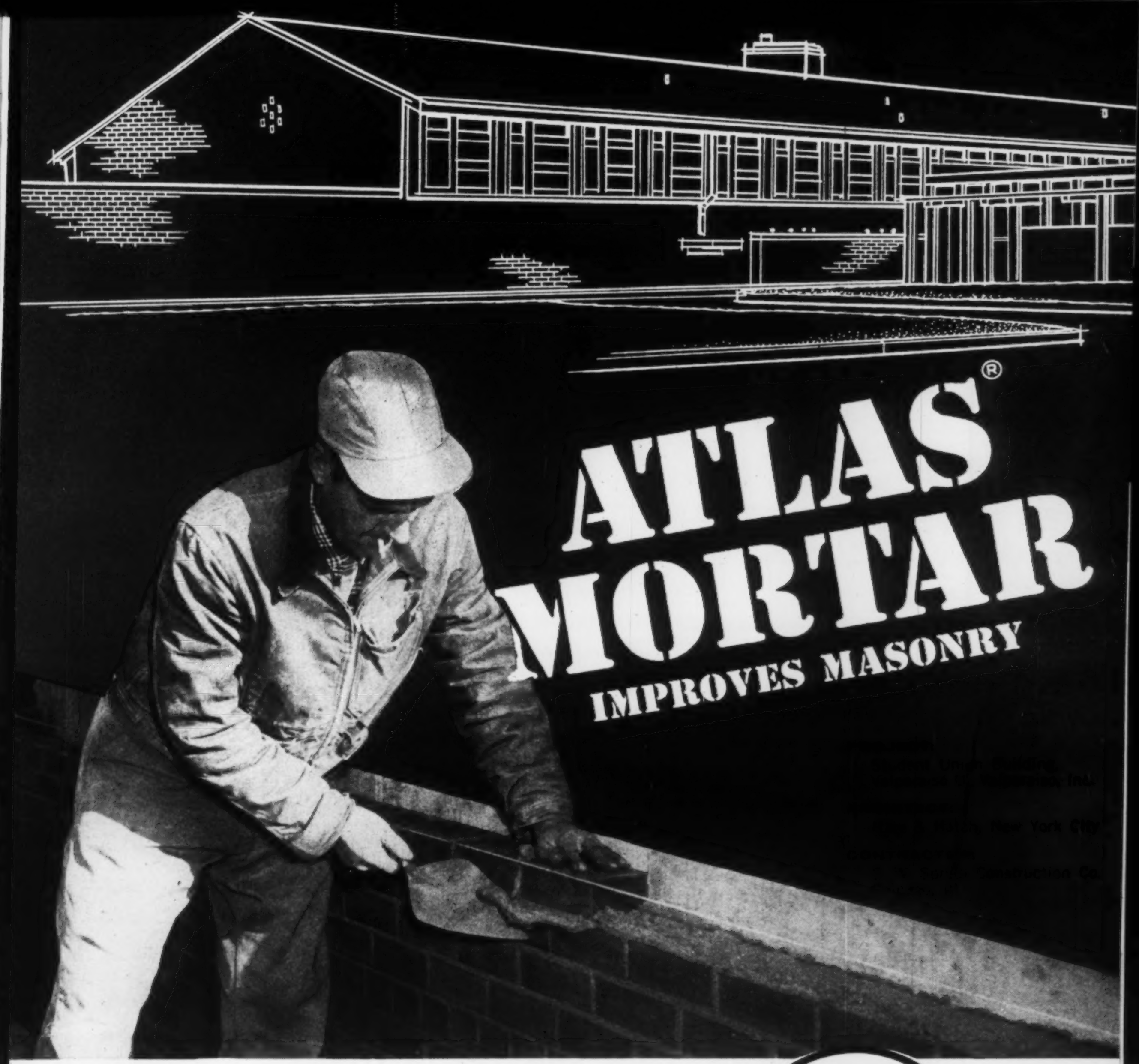
Monotube piles were supplied for this project through a joint venture of the International Cooperation Administration and the National Economic Council under the ICA aid program.

EASY HANDLING with Monotube piles. The strength, rigidity and light weight of the fluted steel Monotube permits a simple one point pick up of this 140-foot pile. The pile being quickly and easily positioned for driving is one of 4310 piles manufactured by Union Metal for use in the improvement and reconstruction of piers in Manila Harbor.

Tapered, fluted Monotube piles are available in lengths, diameters and gauges to meet every requirement. Write The Union Metal Manufacturing Co., Canton 5, Ohio, for complete information.

UNION METAL

Monotube Foundation Piles


ATLAS® MORTAR
IMPROVES MASONRY
[illegible] Union Building
[illegible] Inc.
[illegible] New York City
[illegible] Construction Co.

". . best in workmanship . . . best in strength,"

says Henry Gagne, Masonry Foreman,
E. W. Sproul Construction Co.

- Mortar in masonry construction must resist the destructive effects of weather in any climate.
- Because ATLAS MORTAR is an *air-entraining* masonry cement, it produces a durable mortar that strongly resists deterioration due to weather.
- Quality-controlled manufacture of ATLAS MORTAR cement maintains high product standards, assures uniform performance and appearance on every project. *(Complies with ASTM and Federal Specifications.)*

Write for your copy of "Build Better Masonry,"
Universal Atlas, Dept. M, 100 Park Avenue, New York 17, N. Y.

M-72

UNIVERSAL ATLAS CEMENTS

Universal Atlas Cement
Division of United States Steel

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CATERPILLAR

BUILDING THE WORLD'S MOST PRECISELY ENGINEERED HIGHWAYS

A fleet of CAT-built machines worked to exacting standards constructing loops for the AASHO Road Test. Grading operations alone required 114 engineers and technicians, 50,000 tests.

Caterpillar DW21s and DW20s with Scrapers helped move 1¼ million cu. yd. of earth in 3 months. At peak, more than 25,000 cu. yd. were moved daily. About half of this was placed in the upper three feet of embankment under strict controls for uniformity.

Caterpillar D8 Tractors pulled pneumatic rollers for precisely measured compaction. Gross weight of the unit is 15 tons; weight per square inch of tire—425 pounds. Seven to eight passes were required to provide the density demanded.

In La Salle County, Ill., six highway test loops make up what is probably the most rigidly engineered and supervised highway construction job in history.

It had to be. For these roads are the site of the largest, most comprehensive highway research project ever undertaken. Known as the AASHO Road Test, its prime objective is "to study the behavior of pavements of known thickness under dynamic loads of known magnitude and frequency.".

Results of the $22 million test will be reported to Congress and probably will affect highway design and construction for years to come.

As is standard on any exacting, important highway construction job, Cat DW21 and DW20 wheel Tractors, D8 track-type Tractors and No. 12 Motor Graders were put to work by S. J. Groves and Sons Co. and Arcole-Midwest Corp. These machines, with their high availability record and minimum maintenance requirements, helped move 1¼ million cu. yd. of earth in 3 months under controls more strict than ever before attempted in large-scale highway construction. Grading operations were completed for four main loops of 6,600 feet each of four-lane divided roadway, a 4,400-foot loop, and a 2,200-foot loop. Total distance around each of the main loops is 3.1 miles.

For test traffic, trucks with axle loads ranging from 2,000 pounds on a single axle to 48,000 pounds on a tandem axle are scheduled to run 18 hours a day, six days a week, for two years over the five largest loops.

As the big yellow machines rolled on the job, thousands of tests were conducted continuously to assure precise uniformity of the earth in embankments. Compacted density was controlled between 95 and 100 per cent of standard maximum, and moisture content was controlled between plus or minus 2 per cent of optimum. During grading operations, 50,000 tests were performed and 114 engineers and technicians were at work both in construction control and in the materials laboratory.

As is usual in jobs where there is no margin for error, Caterpillar-built machines were at work.

No. 12 Motor Graders, workhorses of highway construction, maintained haul roads and graded to fine tolerances. Grading was carried out in blocks 500 to 800 feet long.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS, U. S. A.

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Design a 2-lane steel bridge to cross a modern

AMERICAN BRIDGE DIVISION of United States Steel announces a $44,000 Steel Highway Bridge Design Competition dedicated to stimulating the engineering mind to a more imaginative, more effective use of steel in the construction of small bridges.

If you, as a professional or design engineer or as a college engineering student, can come up with a more imaginative, attractive and economical design, not only may you win up to $15,000 in award money, but your efforts may contribute materially to the most challenging road-building program ever undertaken. For, according to conservative estimates, the tremendous 41,000-mile Federal Highway Program will call for the construction of at least a bridge a mile!

The competition involves solving a relatively simple but important problem that will not demand too much of your time.

PROBLEM: Get two lanes of traffic across a modern 4-lane highway, in accordance with the standards for today's highways.

OBJECTIVES: Originality of design, greater utilization of the inherent properties of steel, economy, and aesthetic appeal.

REQUIREMENTS: Just one. The steel bridge must comply with the Geometric Standards for the National System of Interstate and Defense Highways using H-20-S16-44 loading. The type of structure, the type of connections, span length and number of piers, if any, are completely up to you since you are designing with steel.

ELIGIBILITY: The competition is open to all professional and design engineers and college engineering students except employees and/or members, and their immediate families, of the following firms and groups:

United States Steel and its subsidiaries, divisions, agents and dealers
Structural steel fabricating firms
American Institute of Steel Construction members
Rules Committee and Judges

See list of awards at right.

RULES AND JUDGING: The competition will be under the supervision of the American Institute of Steel Construction, which has appointed a Rules Committee and a panel of judges composed of prominent consulting engineers and architects.

DEADLINE: May 31, 1959.

SEND FOR YOUR ENTRY BOOKLET NOW: Contains complete information on the Steel Highway Bridge Design Competition—everything you need to know to prepare your entry. Just fill in and mail the coupon and get started with your design without delay.

USS is a registered trademark

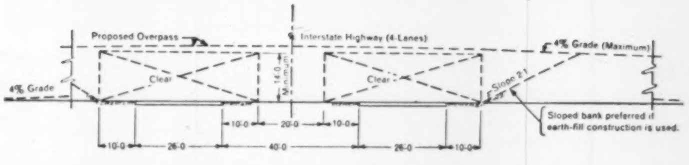
highway... **$44,000 in cash awards!**

Awards for Professional Engineers

1st Award	$15,000.00
1st Honorable Mention	$10,000.00
2nd Honorable Mention	$ 5,000.00
Five 3rd Honorable Mentions	$1,000.00 each

Awards for College Engineering Students

1st Award	$4,000.00
1st Honorable Mention	$2,000.00
2nd Honorable Mention	$1,000.00
Four 3rd Honorable Mentions	$500.00 each


Proposed Overpass
℄ Interstate Highway (4-Lanes)
4% Grade (Maximum)
4% Grade
Clear
Clear
14'-0 Minimum
Slope 2:1
Sloped bank preferred if earth-fill construction is used.
10'-0
20'-0
10'-0
10'-0
26'-0
40'-0
26'-0
10'-0

ELEVATION and CLEARANCE DIAGRAM

American Bridge
Division of
United States Steel

General Offices: 525 William Penn Place, Pittsburgh, Pa.

Competition Editor, Room 1831, American Bridge Division
525 William Penn Place, Pittsburgh, Pennsylvania

Please send me a copy of your $44,000 Steel Highway Bridge Design Competition entry booklet.

Name...

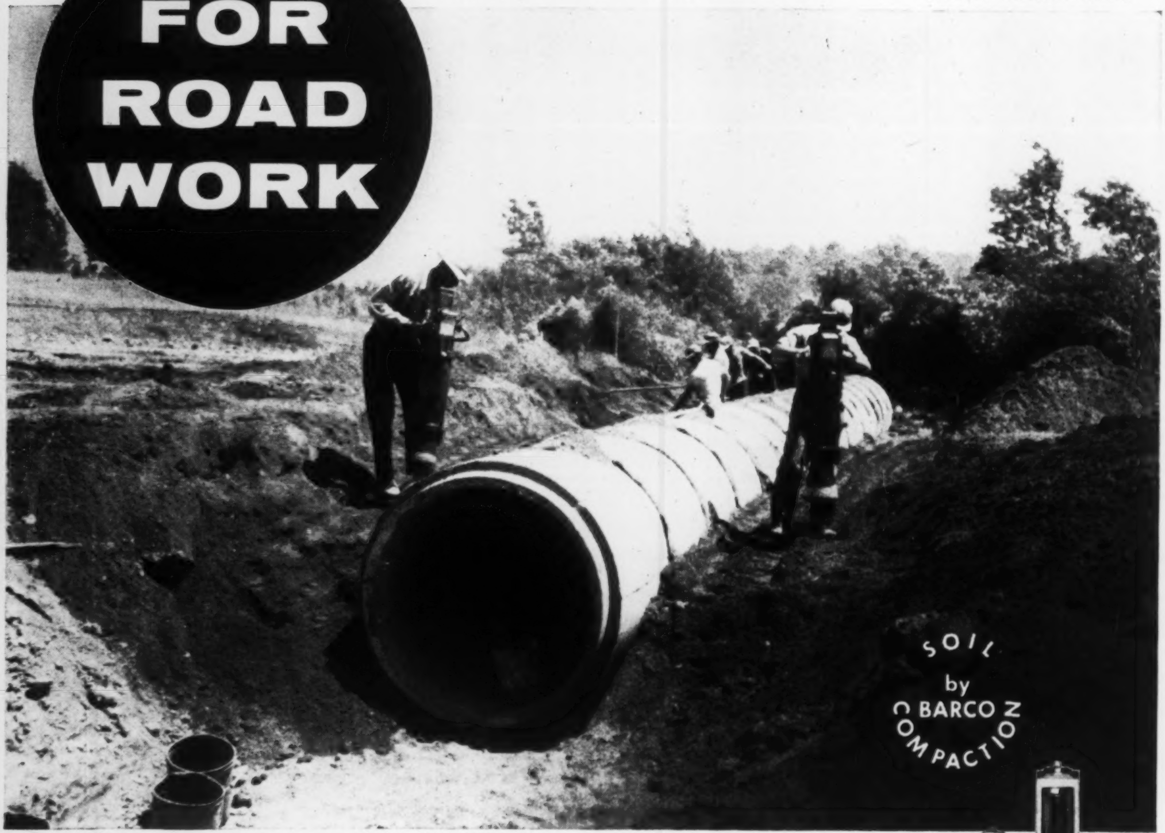
Professional or Design Engineer } (Check one) ....
Engineering Student ....

Address...

City.............................State.................

FOR ROAD WORK

Tamping fill around 4 ft. concrete pipe culvert on New York State Thruway Extension near West Seneca, N. Y. The Barco Rammers are owned by S. J. Groves & Sons Co., Syracuse, N. Y. (Photo: CONSTRUCTIONEER)



Barco Rammers are Essential!

CHECK THE RECORDS for *soil compaction* on every top ranking highway, toll road, thruway, or freeway built in recent years and you will find Barco Rammers! Here are the reasons:

The key to better construction—

No modern trend in construction has had a more phenomenal growth than the specification of HIGH DEGREE SOIL COMPACTION for all kinds of projects for longer life and better value.

Easily meet rigid specifications—

In test after test, Barco Rammers have demonstrated their ability to deliver 95% to 97.5% compaction (modified Proctor Method)—EASILY! EFFICIENTLY! ECONOMICALLY! The Barco Rammer is especially useful for compacting fill in restricted areas. ONLY the Barco Rammer can produce specified high degree compaction on lifts up to 20 inches.

Get jobs finished on time—

One of the biggest advantages offered by Barco Rammers is ability to handle work in minimum time. On area tamping, one man can average 20 to 30 cubic yards of fill per hour. On trench backfill, using lifts up to 24", the rate for 18" trench is 360 to 600 feet per hour. Ask for a demonstration.

PRODUCTS BACKED BY EXPERIENCE
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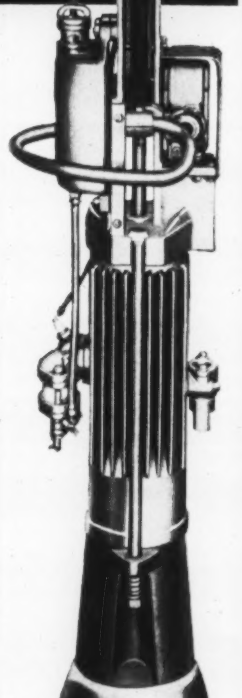
ANNIVERSARY
1908 50TH 1958

BARCO MANUFACTURING CO. **561K Hough St., Barrington, Ill.**

BARCO RAMMER
for High Degree Soil Compaction

BARCO VIBRA-TAMP
for Granular Fill and Bituminous Surfacing



blast furnace slag...

...the aggregate with a plus!

You have your choice of aggregates from VULCAN MATERIALS COMPANY. We produce them all . . . crushed stone, sand, gravel and blast furnace slag. All are of the highest quality, produced and shipped under close and careful control.

Why then, do we recommend blast furnace slag so strongly?

Because it is the one aggregate with the big plus of a built-in safety factor. Tests by independent state and district authorities have established the fact that road surfaces containing blast furnace slag have skid-resistant properties unmatched by any other aggregate. Both when newly paved and after years of service, the rough, vesicular surfaces of slag in the paving material . . . bituminous or concrete . . . afford safe traction, even when wet.

Yes . . . slag is the aggregate with the built-in plus of safety. The value of just one life saved . . . one accident prevented, plus the proved long term economy of slag, will more than justify your selection when you specify blast furnace slag.

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P. O. Drawer 155, Birmingham, Alabama
or the **Lambert Bros. Division,**
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Vulcan Detinning Division • Frontier Chemical Company • Teckote Corporation • Wesco Contracting Company

NEWS OF ENGINEERS

Joseph DiStasio, partner in DiStasio & Van Buren, New York consultants, has been named "Engineer of the Year" by the Institute of Design and Construction in Brooklyn. Mr. DiStasio, an authority on reinforced concrete design, was awarded a "Golden Oscar" for his career which "exemplifies the rise of a man through hard work." Three years ago, Mr. DiStasio's firm was cited by ASCE, the American Concrete Institute, Associated General Contractors of America, and the Concrete Reinforcing Steel Institute for its contribution to the advancement of reinforced concrete construction.

Donald S. Wallace, who has been serving as district engineer for the U. S. Geological Survey in Charlottesville, Va., has recently moved to Arlington. His new address is with the U.S.G.S., at Room 332, Washington Building, Arlington Towers, Arlington 9, Va.

John M. Trissal has been elected vice president and chief engineer of the Illinois Central Railroad. Mr. Trissal has been with the Railroad since 1925 and has served in many capacities, most recently as chief engineer. He is located in Chicago.

Ben Moreell

Ben Moreell, Honorary Member of ASCE, has announced his retirement as chairman of the board of Jones and Laughlin Steel Corporation in Pittsburgh. Admiral Moreell will continue as a director and a member of the executive committee of the board of directors. A wartime commander of the Navy's Seabees, Admiral Moreell served as Chief of the Bureau of Yards and Docks and Chief of Civil Engineers for over ten years. Admiral Moreell joined Jones and Laughlin in 1947 as chairman of the board and president of the corporation.

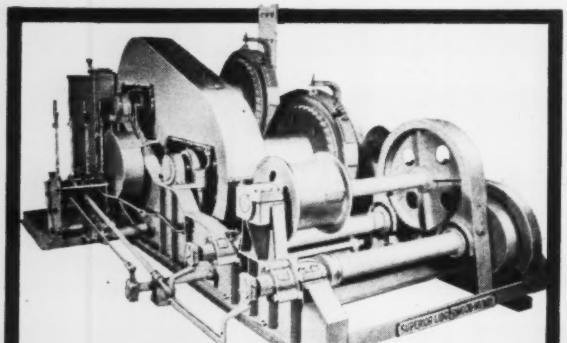
R. B. Pratt has been named a vice president of the Petty Geophysical Company, San Antonio, Tex. Mr. Pratt has been with the company since 1933 and has traveled for it in the United States and Central and South America.

LeRoy A. Brothers has been appointed dean of the College of Engineering of the Drexel Institute of Technology. A graduate of North Carolina State College, Dr. Brothers served on the Drexel faculty for almost 20 years; from 1942 to 1945 he was on leave to work with the National Defense Research Committee. For the past twelve years, he has been at the Headquarters of the U. S. Air Force, in Washington, D. C., as assistant for operations.

H. A. Martin announces the removal of the office of H. A. Martin Associates, consulting engineers, to 136 Liberty Street, New York, N. Y. Mr. Martin was formerly partner in Anderson and Martin, also of New York.

Lindon J. Murphy has taken the post of professor in the Department of Sanitary Engineering at the College of Engineering of the University of Alexandria in Alexandria, Egypt. Professor Murphy was formerly with the University of Missouri at Columbia.

(Continued on page 24)



ELECTRIC DERRICK HOISTS

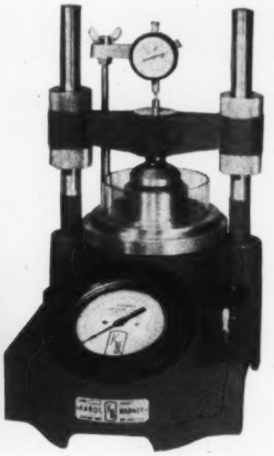
S-L-M serves the St. Lawrence Seaway by supplying Electric Derrick Hoists as shown.

Your derrick hoist requirements can also be met with hard working, durable Hoists and Swingers arranged, designed and built to your requirements.

Flexibility of design is a feature of these hoists as each is arranged to suit exact requirements, yet consist of a combination of standard parts.

Write for Bulletins and Catalogs

SUPERIOR-LIDGERWOOD-MUNDY CORPORATION
Main Office and Works: SUPERIOR, WISCONSIN, U.S.A.
New York Office, 7 Dey Street, New York 7, N. Y.



Unmatched for Efficient Consolidation Soil Testing...

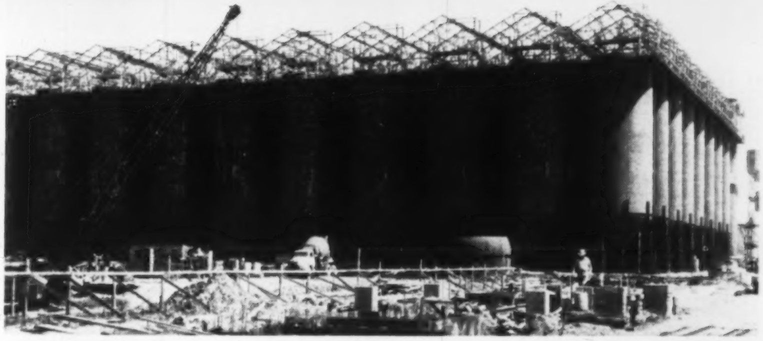
OLSEN K-W Conbel

- Infinite choice of loads
- Load applied instantly without shock
- Capacities from 750 lbs. to 10,000 lbs.
- Simplified controls—one man operation
- Air operated—no dead weights
- Compact . . . light weight . . . portable

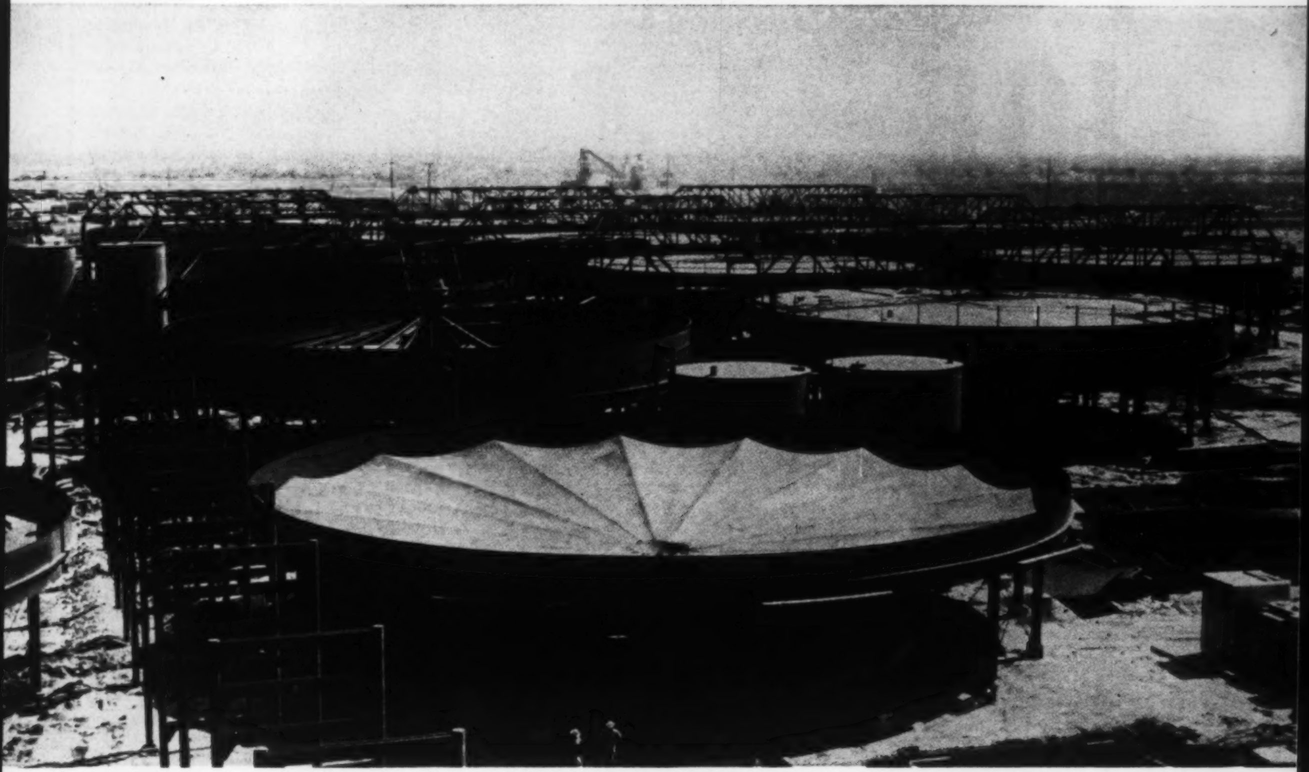
For information about the Conbel and other modern K-W soil testing equipment for triaxial, unconfined compression, and direct shear testing . . .

Write for Bulletin 50-A

TINIUS OLSEN TESTING MACHINE CO.
2170 Easton Road Willow Grove, Pa.



Part of the 144 cone bottom precipitators fabricated and erected for Alcoa by PDM. The units, each 24′ diameter x 60′ shell height, represent 8500 tons of platework, with another 3100 tons of structural steel on top.



Steel Plate Construction of largest scale for the Chemical Industry by

Pittsburgh-Des Moines

Representative of the breadth of experience and facilities placed by PDM at the service of the chemical industry are our current operations for Alcoa at Point Comfort, Texas. The photos show part of the work in progress for the manufacture of alumina. Directly above, a group of 100′ diameter radial cone bottom mud washers and thickeners, involving 5600 tons of plate fabrication. ● For plate and structural work of any scale, we are always at your service.

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STEEL PLATE WORK

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OR OTHER
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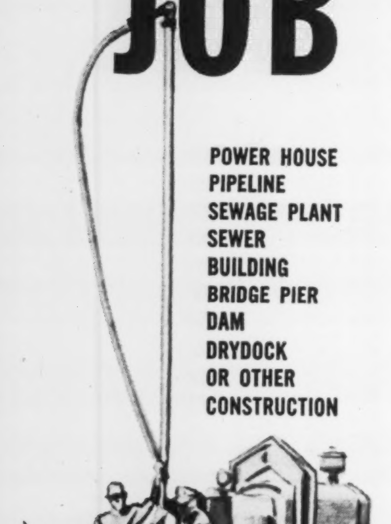

ANALYSIS OF GROUND-WATER PROBLEM AND PRE-BID DEWATERING ESTIMATE WITHOUT OBLIGATION

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In Venezuela: Drew Bear & Sons C.A.

News of Engineers

(Continued from page 22)

Samuel R. Young, Captain, U.S. Air Force, has been appointed deputy chief of staff for installations at Randolph Air Force Base in Texas. Captain Young includes the piloting of jet aircraft in the performance of his installation-engineering duties.

Earl Devendorf, director of the Bureau of Environmental Sanitation of the New York State Public Health Association, has received the Herman M. Biggs Award of the State Public Health Association. An expert on water pollution control, Mr. Devendorf received the award for "outstanding work in the field of public health."

Wayne Teng

Wayne Teng has joined John F. Meissner Engineers, Inc., of Chicago, as head of the structural department. Dr. Teng formerly served as chief structural engineer for Skidmore, Owings & Merrill, Chicago engineers. He has been engaged in the construction of a number of structures for the new Air Force Academy and, earlier, participated in the design of several steam and atomic power plants.

Felix A. Wallace has joined the staff of The Cooper Union in New York as a professor of civil engineering and assistant to the dean of engineering. Prior to this appointment, Dr. Wallace was head of the department of engineering at the College of the Pacific at Stockton, Calif.

Frank C. Mingledorff, C. D. Williams, and Josef C. Patchen of Augusta, Ga., have formed a new firm offering consultation in general professional engineering under the name of Patchen, Mingledorff and Williams. Mr. Mingledorff, formerly a partner in the recently dissolved firm of Patchen and Zimmerman, has been located in Atlanta. Mr. Williams was an associate and chief engineer with Patchen and Zimmerman in Augusta.

Joseph M. DeSalvo has been elected vice president of Joseph S. Ward, Inc., consulting engineers in Caldwell, N. J. Mr. DeSalvo previously served as chief engineer of that corporation.

Robert M. Fraser has announced his retirement as plant engineer with the Rome Cable Corporation, Rome, N. Y. Mr. Fraser's new address is 1001 North George Street in Rome.

Morrough P. O'Brien has been approved by the Senate as a member of the National Science Foundation. His term will run until May 1960. Mr. O'Brien is dean of the College of Engineering at the University of California, in Berkeley.

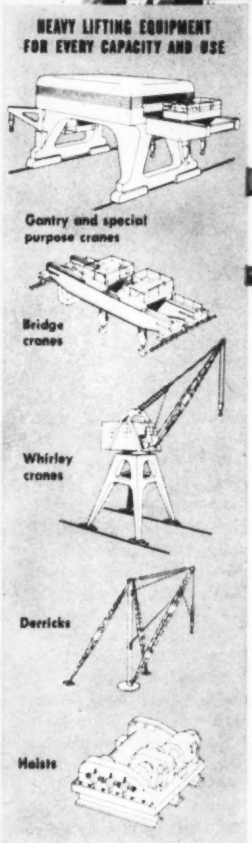
D. B. Ventres

Daniel B. Ventres has become associated with Vogt, Ivers, Seaman and Associates, engineers-architects of Cincinnati, Ohio. With the firm he will serve as consultant and director of the newly established Washington office at 1025 Connecticut Avenue, N.W., Washington 6, D. C. Until January of this year, when he retired after more than 30 years of Federal service, Mr. Ventres was chief of property management for the U. S. Bureau of Reclamation.

A number of Society members have changed their positions as a result of recent Navy Civil Engineer Corps assignments and transfers. New assignments are: **Capt. W. M. Gordon,** commanding officer, Public Works Center, Naval Base No. 3002, FPO San Francisco, Calif., (Philippine Islands); **Capt. P. E. Seufer,** Naval Air Station, Alameda, Calif.; **Capt. F. C. Tyrrell,** resident officer in charge of construction, BuDocks Contracts, 1728 L St., N.W., Washington, D. C.; **Capt. W. F. Wesanen,** U.S. Naval Construction Battalion Center, Davisville, R. I.; **Lt. Comdr. J. B. Adams,** officer in charge of construction, BuDocks Contracts, Navy No. 103, New York, N. Y., (Argentia, Newfoundland); **Lt. Comdr. Dalton Hoskins,** headquarters and service battalion, Fleet Marine Force, FPO San Francisco, Calif.; **Lt. B. G. Crockett,** U.S. Mobile Construction Battalion Center, Port Hueneme, Calif.; **Lt. I. D. Crowley,** District Public Works Officer, Sixth Naval District, Charleston, S. C.; **Lt. E. L. Pickett,** resident officer in charge of construction, BuDocks Contracts, Pacific, P. O. Box 418, San Bruno, Calif.; **Lt. R. J. Schneider,** District Public Works Officer, Fifth Naval District, Norfolk, Va.; **Lt. (jg) M. H. Banta,** U.S. Naval Retraining Command, Portsmouth, N. H.; **Lt. (jg) R. A. Bowers,** U.S. Naval School (CEC officers), Construction Battalion Center, Port Hueneme, Calif.; **Lt. (jg) R. S. Au,** District Public Works Officer, Thirteenth Naval District, U. S. Naval Air Station, Seattle 5, Wash.; **Lt. (jg) A. R. Nash,** District Public Works Officer, Sixth Naval District, Charleston, S. C.; and **Ensign D. L. Eyres,** U.S. Naval Support Unit Three, Antarctica, c/o Construction Battalion, Atlantic, Davisville, R. I. **Rear Adm. C. L. Strain** has announced his retirement from the Navy.

(Continued on page 26)

BIG CRANES BY YUBA


HEAVY LIFTING EQUIPMENT FOR EVERY CAPACITY AND USE
Gantry and special purpose cranes
Bridge cranes
Whirley cranes
Derricks
Hoists

PRODUCTS OF YUBA MANUFACTURING DIVISION AND ADSCO DIVISION

When specialized lifting equipment is needed, industry and prime contractors have found they may profitably turn these problems over to Yuba – from custom design through machining, fabrication, testing and erection – a complete service with a single responsibility. Whenever you need custom lifting equipment – any size, any kind, anywhere – it will pay you to talk with Yuba Engineers. Write or call *Yuba Manufacturing Division, 701 East H Street, Benicia, California, or Adsco Division, 20 Milburn Street, Buffalo 12, New York,* for free copies of Bulletins MA-61 and HY-51 on Yuba facilities, cranes and allied equipment.

YUBA CONSOLIDATED INDUSTRIES, INC.

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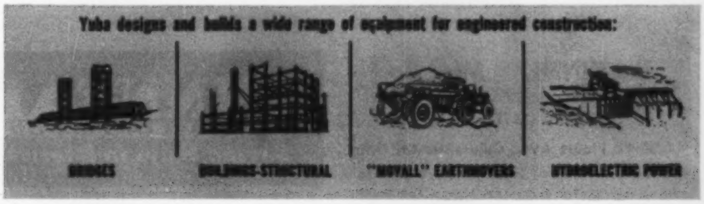
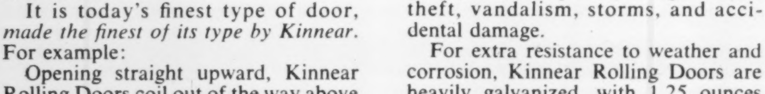
NATIONWIDE

Yuba designs and builds a wide range of equipment for engineered construction:


BRIDGES
BUILDINGS-STRUCTURAL
"MOVALL" EARTHMOVERS
HYDROELECTRIC POWER

Kinnear Rolling Doors

Basic advantages make them first choice in any era...



The door with the curtain of interlocking steel slats was *originated* by Kinnear. Its advantages are basic — as important to door efficiency as the invention of the wheel to improved land travel.

It is today's finest type of door, *made the finest of its type by Kinnear.* For example:

Opening straight upward, Kinnear Rolling Doors coil out of the way above the opening, into the compact hood mounted on the wall either inside or outside the opening (or often within the wall, where desired).

Kinnear Rolling Doors also give you full use of all space around doorways at all times. *No extra space of any kind is needed for their opening and closing action.* And *Kinnear* design makes sure the opened door always rests *above* the lintel — never steals clearance space overhead.

The rugged interlocking steel-slat curtain *(originated by Kinnear)* also gives you added protection against fire, theft, vandalism, storms, and accidental damage.

For extra resistance to weather and corrosion, Kinnear Rolling Doors are heavily galvanized, with 1.25 ounces of pure zinc per square foot of metal (ASTM standards).

Kinnear Rolling Doors are built any size, for easy installation in either old or new buildings of any construction. Manual-lift, chain, or crank operation — or motorized push-button control. Also available in non-ferrous metals. *Write for full details.*

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KINNEAR
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Saving Ways in Doorways

News of Engineers

(Continued from page 24)

Among recipients of awards given by the James F. Lincoln Arc Welding Foundation are several members of the Society. The award designs were made for welded bridges now being built on new interstate and defense highways. Co-winner of one of the two Second Awards of $7,500 each was **Dale C. Hoffmann,** of Columbus, Ohio, who co-designed a four-span 398-ft haunched girder bridge. A team of turnpike engineers in Dallas, Tex., received the other Second Award for the design of an all-welded arch bridge on the Dallas-Ft. Worth Turnpike. **Joe C. Bridgefarmer, Douglas A. Nettleston, and William L. Powell** were the designers. The three Third Awards of $5,000 each were shared by three teams of designers. **Emory Bond, Jr., and Gene E. Ellis,** both of Topeka, Kans., submitted a 273-ft haunched-girder turnpike overpass. **Marcello H. Soto** of Harrisburg, Pa., was co-designer of a 495-ft five-span railroad overpass. **Paul M. Shepard, Jr.,** of Columbus, Ohio, was one of a team of four men who designed a five-span 867-ft haunched girder railroad overpass.

George E. Shafer has retired as vice president in charge of engineering with the Armco Drainage and Metals Products, Inc. Mr. Shafer has been with Armco for 32 years and has served on several Highway Research Board committees. Mr. Shafer is succeeded by **John R. Hursh,** who will take the position of chief engineer of the products engineering staff. Mr. Hursh has been with the company since 1940.

G. E. Shafer

J. R. Hursh

William H. Mills has opened an office for the practice of civil engineering in Atlanta, Ga. Mr. Mills, who is affiliated with Miller-Warden Associates, Swarthmore, Pa., will specialize in soils and materials, design and specifications for pavements, quality control of pavement construction, and analysis of construction operations. Prior to opening his office, Mr. Mills served for four years as consultant on highway pavement design and construction with several state highway departments and the National Department of Highways and Contractors in Brazil.

(Continued on page 27)

News of Engineers

(*Continued from page 26*)

Francis L. Brown, until recently a principal partner in Brown and Blauvelt, Consulting Engineers, will continue the practice of consulting engineering as Brown Engineers at 60 West 55th Street, New York, N. Y. His former partner, **Harold A. Blauvelt,** will practice consulting engineering under the name of the Blauvelt Engineering Company, with offices at 468 Fourth Avenue, also in New York.

Hugh M. Arnold, Colonel, U.S. Corps of Engineers, has been transferred from the Panama Canal to the post of commanding officer of the 20th Engineer Brigade at Fort Bragg, N. C. Since July 1957, Colonel Arnold has served as Lieutenant Governor of the Canal Zone and vice president of the Panama Canal Company, after a three-year assignment as director of the company's engineering and construction bureau.

H. M. Arnold

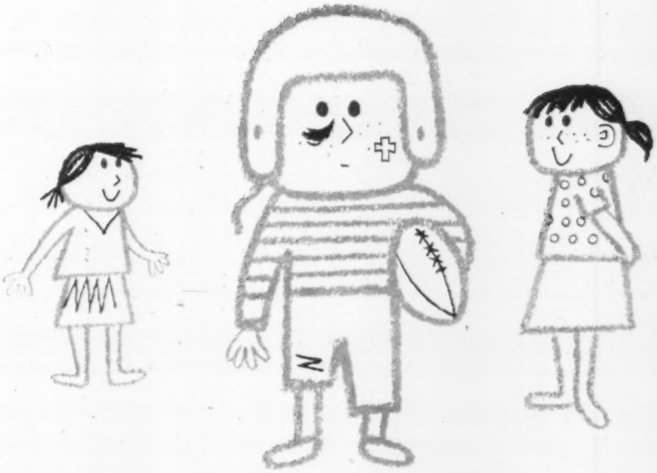
Alexander C. Husband, Captain, U.S. Navy Civil Engineer Corps, has been transferred to the First Naval District as District Civil Engineer and District Public Works Officer, with headquarters in Boston. Captain Husband has just completed a tour of duty as commanding officer of the Naval Construction Battalion Center at Davisville, R. I.

Bennet W. Burns and **S. J. Bell** have taken on new responsibilities with H. E. Bovay, Jr., consulting engineers in Houston, Tex. Mr. Burns will assume the duties of managing partner in the Houston office and Mr. Bell will become assistant chief engineer in Houston. Both men have been with the firm in other capacities.

George E. Spargo has been elected director of the Brooklyn Borough Gas Company. Mr. Spargo, who is general manager of the Triborough Bridge and Tunnel Authority, also serves as deputy city construction coordinator for the City of New York and as assistant to the chairman of the Slum Clearance Committee.

Arno T. Lenz has been chosen chairman of the University of Wisconsin College of Engineering's department of civil engineering. Professor Lenz has been on the university staff since 1929. He was graduated from the university in 1928.

(*Continued on page 110*)



In greatest demand...

Today more engineers are specifying Rodney Hunt HY-Q Sluice Gates by name than any other gate. The reason for this strong preference is found in the inherent advantages of the HY-Q flush bottom closure design.

Unlike any other design, the HY-Q gate seats on a sill which is flush with the invert. There is no vertical sill wall or trough to create turbulence, trap debris and silt, obstruct free flow, prevent proper seating of the gate. It permits complete drainage of the channel without pumps and assures maximum hydraulic gradient at the bottom of the gate.

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The first basic sluice gate improvement in years features a resilient seal fastened to the bottom of the sliding disc to provide a cushioned closing at the stop bar. This flush bottom closure results in specific construction economies for a given volume of flow... smaller gate size, narrower channels, lower channel walls. It provides unmatched design flexibility for water, sewage treatment and similar projects... with more than 80 gate sizes available, ranging from 12" x 12" to 190" x 120".

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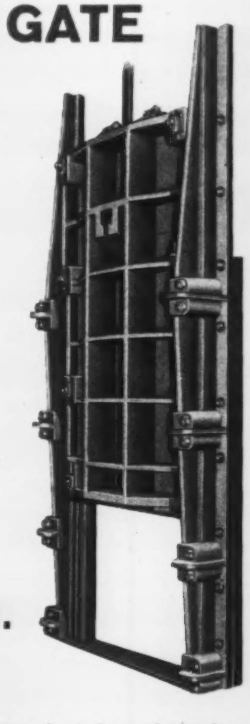

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of Long Beach, Calif., sell and install the heavy-duty field-proven Prefabricated Asphalt Linings manufactured by Envoy Petroleum Co., under license by Gulf Seal Corp.

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A portion of one installation alone, totaling more than twenty-five acres of lined pit area, is shown above. What cannot be shown are the more than twelve million square feet of this material in use in hundreds of important installations.

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. . . . . Am-Soc Briefs

▶ ▶ Four of every five members of ASCE hold a Professional Engineer's license or an Engineer-in-Training Certificate. This was among the facts disclosed by the recent questionnaire on "Employment Conditions". Another interesting revelation is the decline in number of Society members in collective bargaining organizations during the past five years. The decline is from 3.6 percent in 1953 to 2.3 percent now. For a breakdown of these figures and other significant data, see the reports on page 79 of this issue.

▶ ▶ Milwaukee's burghers were hosts to the Society's annual meeting of the Department of Conditions of Practice, August 2-3. Gathered together were representatives of the nine national committees which look after the professional interests of our members. The latest Federal Aid to Education Bill was reviewed; the employment conditions report was released; consideration was given to developing a program for the recognition of certificates issued by the National Bureau of Registration by all states; plans were made for the 1959 salary survey; the revised Manual No. 29 (on Professional Practice) was scheduled for release in the late fall; and legislation for increasing the pay of Federal employees was considered.

▶ ▶ Orchids to the Kansas City Section for gaining a larger number of dues-paying members (112) during the calendar year 1957 than any other Section-from 356 in 1956 to 468 in 1957, an increase of 112. More than three-fourths of the assigned membership of the Section support its activities financially. Local Section reports for 1957 also show that 45 Sections had more dues-paying members than during 1956; and that in the aggregate 897 more members assigned to Local Sections paid local dues than during the previous year.

▶ ▶ Pledges and gifts to the United Engineering Center from voluntary contributions of members have reached the first 10 percent of the $3,000,000 part of the over-all goal. Local Sections of ASCE have completed their organization and the member-giving campaign is entering the decisive stage. The Industry Campaign, too, is moving ahead rapidly, having passed 70 percent of its $5,000,000 goal.

▶ ▶ Strengthening the membership of the Society by raising qualifications is the purpose of proposed amendments to the Society's Constitution. Also it is proposed to change the names of the grades of members to conform to those recommended by ECPD and adopted by most of the Founder Societies. A review of the proposals appears on page 33 of this issue.

▶ ▶ Another Government agency, the ICA, has acknowledged the merits of ASCE's recommended policy of engaging professional engineering services by negotiation on the basis of ability to serve rather than lowest bid. News of this gratifying change in policy and some of the details of Directive No. 12 are recorded in the Society News section of this issue.

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HONEYWELL

WATERSPHERES®

put beauty and prestige to work on Plant Security

Skyline advertising with CB&I Waterspheres makes good sense to good businessmen. Sales managers, plant managers and comptrollers are quick to agree that Waterspheres, a sound investment in plant security and dependable water pressure, also *pay off* in: (1) savings of up to 60% in fire insurance premiums and (2) demonstrated prestige and the benefit of skyline advertising.

Waterspheres are designed to complement the beauty and utility of modern plant architecture; but they are *built* for service. They require less ground area than conventional tanks, are easier to paint and maintain . . . and the base can be used for pumping or storage.

Waterspheres are another product of CB&I's *creative craftsmanship in steel.* Write our nearest office for descriptive literature.

◀ 100,000 gallon Watersphere serves Minneapolis Honeywell Regulator Company at Golden Valley, Minnesota. It is 100-ft. to bottom and stores water for general plant use and the sprinkler system. Ellerbe & Company were architects and engineers.

Waterspheres are designed, fabricated and erected by CB&I in capacities of 25,000 to 250,000 gallons.

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do you know that

In 1955-56 Russia graduated more than twice as many civil engineers (first degree only) than did the United States? Furthermore, American college students spend less than half as much time in class as do Russian undergraduates. The young Russian entering college in 1955 had studied five years of physics, four years of chemistry, five years of biology, ten years of mathematics, and one year of astronomy. The shocking corresponding figures for the United States are that less than one-third of our high school graduates had taken a year of chemistry, about one-fourth had had one year of physics, and less than one-seventh had studied mathematics beyond simple arithmetic or first-year algebra.

• • •

The world's airlines have ordered 700 jet aircraft for commercial use with switchover to start this fall? Planes include several versions of the Boeing 707, which will carry 90 to 150 passengers; one model has a maximum take-off weight of 247,000 lb and an air speed of about 600 mph. There is a challenge to have airports ready to handle the fast, heavy, and perhaps noisy machines when they are ready for the skies.

• • •

An Antarctic mountain range rising 5,000 ft above the ice (9,000 ft above sea level) was recently discovered 500 miles from the South Pole? The 30-mile stretch of rugged peaks is named the Dufek Massif for U.S. Antarctic commander, Rear Adm. George Dufek. Areas free of ice and snow, one of which contains a fresh water lake with plant life, have been reported in the discovery which ranks as major achievement of the 1958 explorations of the world's least-known land mass.

• • •

Leasing of equipment by the road-building industry has increased sharply? About $18 million worth of such equipment is being leased now as compared to $2 million five years ago. Proponents of leasing—please use our money to earn more for both of us—say that organizations that earn more than 12 percent on working capital, after taxes, find leasing most profitable.

• • •

A photo-theodolite was used to measure the remote Egyptian Monastery of Saint Catherine, built in the sixth century on the site of the "burning bush" where Moses first heard the word of God? The work was done by Ralph M. Berry, M. ASCE, professor of geodesy and surveying at the University of Michigan. He used an instrument, borrowed from the U.S. Coast and Geodetic Survey, which normally is used for mountain surveying. Photos were obtained that will permit continuing study of the monastery if access is denied in the future.

• • •

International Geophysical Cooperation will operate in 1959 as a smaller scale extension of the International Geophysical Year for global accumulation and exchange of scientific information? This is a plan that has come out of the IGY meeting in Moscow in August which drew 400 scientists. Ways and means to gather and distribute scientific data in the future will be studied as those already gathered are analyzed and digested.

• • •

University of Michigan research indicates that radioactive waste products of nuclear power reactors could be used in water and sewage treatment plants? A 99-percent reduction in harmful bacteria can be effected at a lower cost for plant operations. This method, which seems to be the most economical yet proposed, would take advantage of the tremendous amounts of radioactive waste now stored in underground containers. University scientists say harmful bacteria could be killed by running water or sewage past a core of radioactive waste products, without the water or the suspended material becoming radioactive.

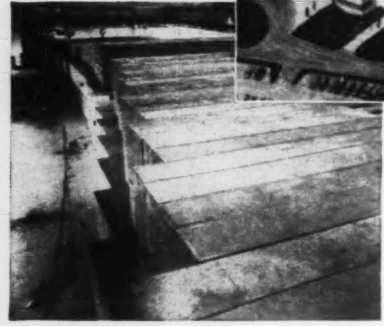
• • •

Two atomic-powered submarines of the U. S. Navy passed under the Arctic ice cap at the Pole? Of course you do, but this potential use of atomic power for propulsion of commercial ships and the feasibility of the polar route for undersea craft should be recorded. Both the *U.S.S. Nautilus* and the *U.S.S. Skate* passed under the North Pole within eight days of each other in August. The *Skate*, with a 2,400-ton displacement, is 265 ft long; the larger but similar 3,200-ton *Nautilus* is 348 ft long. Also in August, the world's largest submarine, the 5,900-ton 447-ft *Triton* went down the ways at Groton, Conn. She is powered with two reactors. The U.S. has built, is building, or has authorized 22 nuclear-powered submarines.

• • •

Water works and sewerage contracts awarded during 1957 passed one billion dollars? According to the U.S. Public Health Service's recently released publication No. 608, "Sewage and Water Works Construction—1957," contracts for sewage treatment works reached $350 million, for collecting sewers nearly $250 million, and for water works over $450 million.

'Incor' Concrete Shield for Atomic Targets



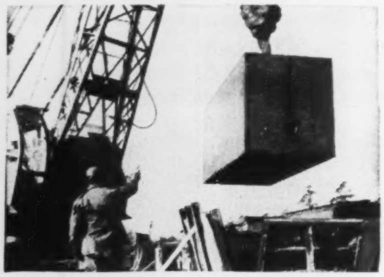
MASSIVE SHIELDING (left). Dense concrete blocks, weighing as much as 34 tons, enclose experimental area in Target Building.

(right) Speeding protons are guided in tight beam around synchrotron ring by a series of magnets.

ASSOCIATED UNIVERSITIES, INC.
BROOKHAVEN NATIONAL LABORATORY
Target Building, Upton, New York

High Density Concrete Shielding Blocks
PRECAST BUILDING SECTIONS, INC.
New Hyde Park, Long Island, New York
Main Office: New York City, N. Y.

'Incor' Concrete Supplied by
SUFFOLK SAND & STONE CORPORATION
Yaphank, Long Island, New York



HIGH-DENSITY CONCRETE (above). 'Incor' concrete, of over 246 pounds per cubic foot, was cast at contractor's batching plant in winter weather.

High-Density 'INCOR' Concrete Encloses Target Area in Brookhaven's Half-Mile Synchrotron

- To minimize the possibility of radiation, massive shielding blocks of extremely dense concrete enclose the target area of the Alternating Gradient Synchrotron at Brookhaven National Laboratory, Upton, New York.

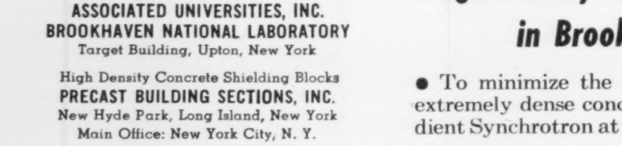
The synchrotron will be the world's mightiest atom smasher. Speeding protons will circle the half-mile underground track 300,000 times per second. Accelerating to a top energy of 25 to 30 billion electron volts, they will smash into stationary target atoms.

Enclosing this target area is a total of 1,446 high-density 'Incor' concrete shielding blocks. These range in size from 1′ x 1′ x 4′ plug blocks to massive cover beams measuring 4′ x 2′ x 34′ and weighing up to 34 tons. In the shielding blocks, iron ore aggregate was used to produce concrete weighing over 246 pounds per cubic foot.

Produced by conventional mass-production methods, strict laboratory standards were maintained. Each shielding block was cast to strictest dimensional tolerances, with the maximum allowable deviation of only ⅛-inch between parallel faces.

Modern concrete know-how made it possible to cast the blocks at an off-site plant during winter months at temperatures as low as 20 degrees F.—with night temperatures often at zero. 'Incor',* America's FIRST high early strength portland cement, permitted forms to be stripped in 24 hours.

*Reg. U. S. Pat. Off.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'INCOR' HIGH EARLY STRENGTH PORTLAND CEMENT
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LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 21 MODERN MILLS, 48,900,000 BARRELS ANNUAL CAPACITY

A new classification of members proposed

Should the present classification of members of our Society be changed? Should the requirements for the grades be different from what they now are? Answers to these and related questions are expected to be provided by a vote of the membership later this year.

Over the years many serious members have suggested ways of strengthening the Society's membership, but previous constitutional amendments relating to such changes have been defeated when submitted to vote. Taking cognizance of the continuing pressure for some change in membership grades, the Board in 1956 appointed a ten-man Task Committee on Classification of Members, headed by former Vice President Frank L. Weaver, to ascertain the true desires of the membership. The committee's interim report to the Board at Buffalo in June 1957 was printed in full in the July 1957 issue of CIVIL ENGINEERING, pp. 81-82, for review and comment by the membership through the Local Sections. The Task Committee advised the Board at Chicago, in February 1958, that it had given full and careful consideration to all views and comments received, and reaffirmed the recommendations in its report to the Board of June 1957.

Still moving prudently, the Board asked the Task Committee to obtain written comments from each member of the Board, to analyze them, and to report again at the Portland Board meeting. At Portland on June 23-24 the Board accepted the report of the Task Committee as printed in the July 1957 CIVIL ENGINEERING, with minor changes in wording and a change in the name of the proposed top grade of membership to "Fellow."

To implement this action, the Board discussed fully the wording of enabling amendments to the Constitution and gave the Executive Committee power to clear the final wording, after examination by, and advice from legal counsel. On August 1, the Executive Committee approved the wording of the enabling amendments and requested the four Vice-Presidents to obtain the 200 member signatures to the petition in each Zone, as required by the Constitution before an amendment can be submitted to vote. Unless 800 members indicate their wish to have the matter resolved one way or the other, the amendments cannot be brought to vote. By the time this is being read the petitions probably will have reached the Secretary and he will have mailed to each member for his advance information the wording of the amendments. At the Annual Meeting of the Society to be held in New York on October 15, the proposed amendments will be approved or amended or referred to committee for further consideration. If approved by the meeting in the form submitted, or as amended, the amendments will be submitted to letter ballot of the membership. Two-thirds of the valid votes cast must be in the affirmative for adoption.

With this explanation of the care taken to learn the wishes of the membership, and the machinery needed to bring an amendment to vote, it is important to take a brief look at the changes that are being proposed:

First, membership standards would be raised, not lowered.

Second, registration would be a requirement for the top grade of membership.

Third, the names of the new grades of membership would generally conform to those used by a majority of the Founder Societies, and would be in accord with the recommendations of Engineers Council for Professional Development.

Fourth, graduation from an engineering school of recognized standing, or possession of an acceptable certificate as an Engineer-in-Training would be required for admission to the lowest grade. Membership in this grade, with some exceptions, would cease 12 years after admission to it.

Fifth, the name of the lowest grade of membership, now Junior Member, would be changed to Associate Member. All present Junior Members would automatically become Associate Members.

Sixth, present requirements for admission or advancement to the Associate Member grade would be strengthened to include either graduation plus 10 years of active practice, or in the case of non-graduates, 12 years of active practice—plus three years of responsible charge of engineering work in each case.

Seventh, the name Associate Member would be changed to Member, and all present Associate Members would automatically become Members.

Eighth, there would be no direct admission to the top, or Fellow, grade of membership. Admission would be by transfer from the new Member grade. The requirements for the Fellow grade, with minor exceptions, would be that the applicant be at least 40 years old; have legal registration; and have had at least five years of responsible charge of important engineering work while in the Member grade.

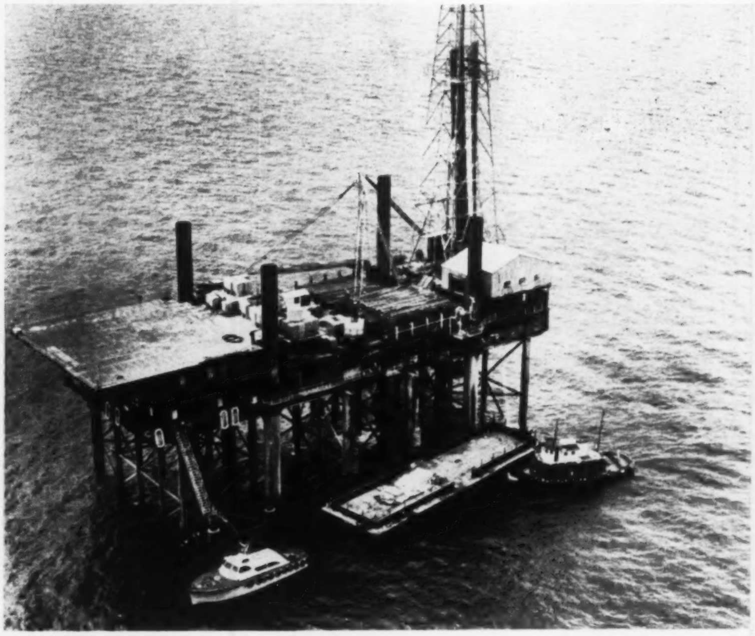
Ninth, the name of the present Member grade would be changed to Fellow, and present Members would automatically become Fellows.

Tenth, the requirements for the Affiliate grade would be lowered somewhat. An Affiliate would have the qualifications of the new Member grade in his special pursuit, qualifying him to cooperate with engineers in the advancement of professional knowledge and practice.

Eleventh, those in the present Junior Member and Associate Member grades would have a one-year period of grace in which to apply for advancement under the requirements in effect before passage of the amendment, and when advanced, they would become either Members or Fellows as the case might be.

Twelfth, entrance fees and dues would be modified slightly, and the fee now required for transfer from one grade to another would be eliminated.

This important matter of membership changes can be resolved by the "Yes" or "No" votes of an informed membership. Make your vote count when the time comes.



Offshore drilling barge in operation. Note helicopter landing deck. Rig can drill wells in 100 ft of water.

Pipelining in marsh, swamp—

WILLIAM T. IVEY, M.ASCE

Chief Statistician and Planning Engineer, Southern Natural Gas Co., Birmingham, Ala.

Any old-time driller will tell you that "natural gas is where you find it." And, as the demand for gas continues to grow, the search extends further and further afield, away from developed areas and away from proximity to markets. One of the vast areas in which new gas supplies are being found is southern Louisiana, where land is sea and sea is land, where men move around in boats and highways are flowing streams.

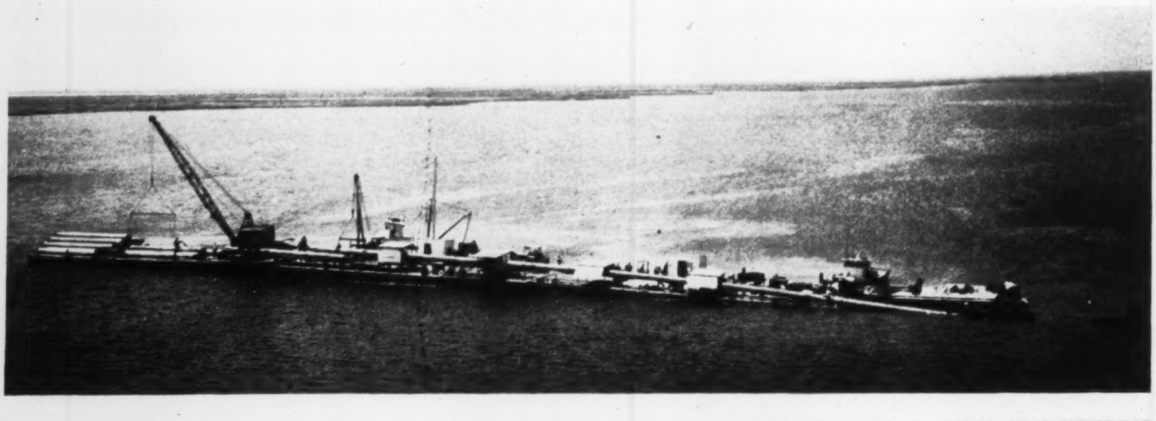
Down in the Cajun country, where once Jean LaFitte hid out in Barataria, drilling rigs are finding more wealth than all the pirate gold. More is spent by one pipeline company to bring the gas ashore than the purchase price of all Louisiana. Let us go down the bayou and through the marsh into the open water to see this miracle.

South from New Orleans extend seemingly endless swamp and marsh, cut by meandering bayous. Some swamp areas are covered with a thick growth of cypress trees, festooned with Spanish moss. Further out toward the open water the land is soft and spongy and covered with tall marsh grass. It is difficult to distinguish land from water, and quite impossible to walk in most of it.

Here trappers have run muskrat trap lines for generations, oyster fisherman have worked the bottoms in sheltered areas, and shrimp fishermen have put out to sea in small boats. Here ways of life have been the same for generations, and the people resist the foreign pipeliner who is changing the face of their water bottoms.

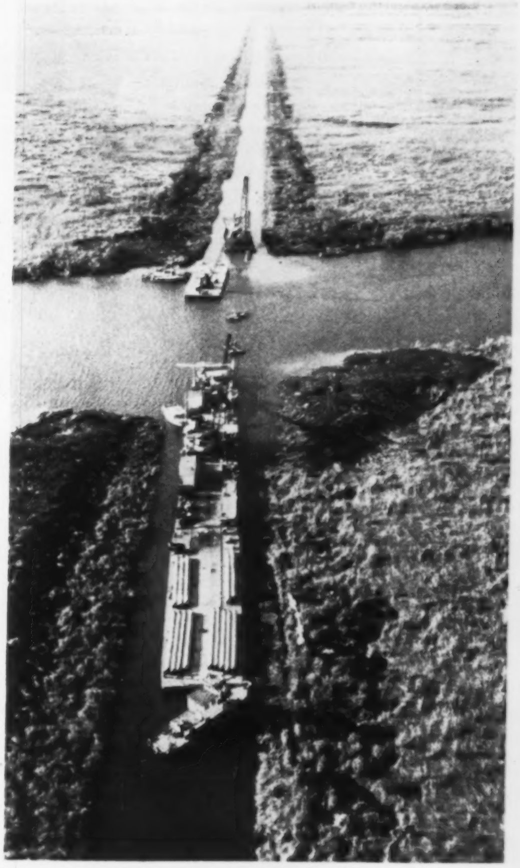
Offshore drilling and pipelining

As we emerge from the bayou and move out into the open water, our eye is caught by a number of hugh behemoths standing in the water like mastodons on metal legs, with long necks upthrust to look around (photo above). These are the offshore drilling barges, perhaps 200 x 100 ft in plan and varying in size from 2,500 to 4,600 tons. They provide living accommodations for operating person-



Olga Compressor Station of Southern Natural Gas Co. is in marsh near mouth of Mississippi. From receiving platform in background, gas moves through two compressor units on middle platform into 20-in. pipeline running through canal occupied by crane barge.

Articulated lay barge advances toward camera across section of Intracoastal Waterway, leaving pipeline in place behind—in canal in background. Laying procedure is similar to that by sea-going barge.



—and open water

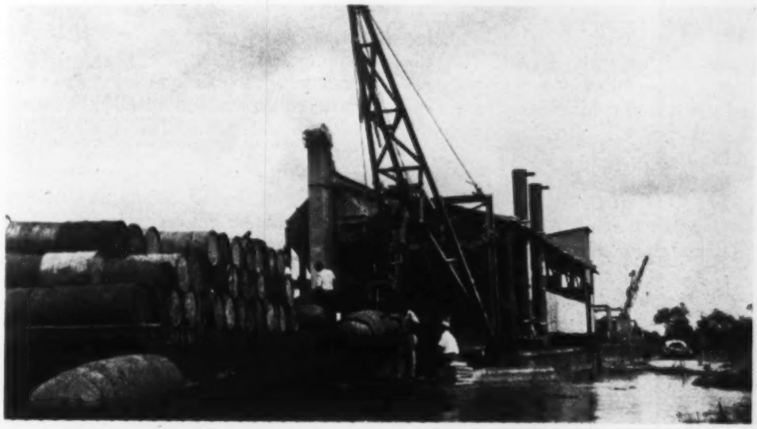
nel and are completely mobile. Such barges may be equipped with towers or legs which can be lowered to the floor of the ocean at drilling locations and which, by means of jacking mechanisms, elevate the barge above the water surface. Some barges are of submersible type. Frequently they are equipped with helicopter landing platforms.

Drilling can proceed from such platforms in 100 ft of water, to depths of as much as 20,000 ft. Such a drilling barge costs several million dollars, one reason why offshore drilling is an expensive operation.

From a well, or group of wells, drilled in such a manner, gas must be brought ashore. Since the pipeline will be laid under water, buoyancy must be considered and the pipe weighted adequately. Protection from salt water and marine life is also essential.

In the offshore pipe-laying barge pictured at left, the pipe has been yard-coated with concrete and the coated section of pipe brought to the lay barge by a shuttle barge. The shuttle

Timcoat barge covers pipe with asphalt-mastic weight coat and lays continuous pipeline as it moves ahead. Floats prevent great weight of pipe and weight coat from cracking coating through excessive overbend. ↓



←
Offshore pipe-laying barge lays finished line of weighted, precoated pipe in one continuous operation.

Right-of-way is cleared for pipeline by pirogue-mounted Cajun woodsmen in southern Louisiana swamp. Ax blow would send pirogue skittering off except for agile foot-work.

barge has been linked to the lay barge and lengths of pipe are being transferred to the lay barge and lined up for the first welding station located in the first small tin-roofed shed.

As each welding operation is completed, the barges move to the left to bring the joint to the second welding station for the final weld, and a new joint of pipe is lined up for welding. The third barge contains the X-ray station, where a check is made of each weld by exposing film wrapped around each joint to radioactive cobalt. Next is the station at which the patch of hot asphalt paint, glass-fiber wrap and final concrete coating is applied to the field joint inside a sheetmetal mould. As each joint is welded, tested and coated, the barges move ahead, out from under the pipeline, which is allowed to sink to its proper location. As the pipe moves off the barge, it is lined up for final position by the surveyor in the small boat at the extreme right.

In some methods the lay barge is anchored in a fixed position and the pipeline is floated and pushed or pulled into position. On soft bottoms the pipe is eased into its bed by means of jets that scour out the final underwater trench. In more open water, subject to rough seas, a converted Navy landing ship has been used as a lay barge because of its greater stability.

Offshore compressor stations

As gas is moved to shore, receiving stations must be built and, if pressures require, compressor stations installed to force the gas into pipelines against line pressure. Such a station is Southern Natural Gas Company's Olga Compressor Station, located in Plaquemines Parish, La., near the mouth of the Mississippi. Gas from over a dozen offshore and marshland fields is brought to Olga through four lines, at various pressures, and introduced into a pipeline of 20-in. diameter.

Olga Compressor Station is seen under construction on page 35. The receiving station is being constructed on the furthest platform, the four gathering lines coming in through the various channels radiating outward from the receiving station. Two compressor units may be seen on the middle platform, which will be connected to the receiving station by a catwalk carrying two pipelines. The engines will later be housed in a metal building.

The barge-mounted crane in the foreground is setting in place a platform that will contain the microwave tower and housing for control equipment. The three platforms will be connected by steel bridges to carry connecting pipelines and walkways for personnel. The platforms are erected on 112-ft prestressed concrete piles set through a template. The piles sink 45 ft in the muck by their own weight and then are driven to bring their tops 18 ft above mean sea level. No solid foundation was found; the weight is held by skin friction alone.

Prefabricated platforms were barged in and set in place by the crane. All equipment, including the compressors, had to be barged in and set in like manner. Personnel housing and cooking facilities are on the barge in the foreground.

The engines are two 660-hp Ingersoll-Rand SVG-12 skid-mounted reciprocating units. They will be operated by remote control by microwave from a manned station 42 miles away. The microwave system will handle communications, transmit routine operating information, and control signals. There will be one intermediate repeater station. Routine maintenance and repairs will be carried out on periodic trips to the automatic station by boat or plane.

The microwave system will serve three main functions:

First, by telemetering to a recording chart at the manned station, it will supply a continuous record of suction and discharge pressures and engine revolutions per minute, and a selective telemetering of information such as lubricating-oil pressure and temperature, jacket-water temperature, fuel-gas pressure and suction, and discharge gas temperature. Also there will be a wall-mounted piping diagram at the control station which will record all valve positions continuously by red and green lights.

Second, by means of telemetered control signals, the operator at the control station can stop or start either engine, can raise or lower the speed of either engine manually, or can set either engine to operate automatically on a constant-suction-pressure controller. The automatic station will have automatic emergency shutdown and will automatically close line valves and open blowoffs. The engines can be reset and started by microwave control.

Third, there will be a two-way, microwave telephone circuit between the automatic station and the control station.

"Marsh lay"

Moving inland from the uncertain shore line, the pipeline will cross miles of quaking marsh for the "marsh lay." The natives, descendants of French Arcadians, make their living from fishing, trapping and oyster farming. Their home is on the bayou, their transportation by boat. Any change in flow of water, or change from fresh to salt or brackish water, or conversely, will affect the oyster beds, the fishing grounds, or the muskrat trapping lines. Rights-of-way are costly and difficult to obtain. Permits must be obtained from the Corps of Engineers when navigable streams, such as the Intra-

An 18-in. pipeline snakes its way through the Black Belt of Alabama. Sideboom tractors hold pipe as it is hot-coated and wrapped in one continuous operation.

coastal Waterway, are crossed; from the Oyster Division of the Wild Life and Fisheries Department of Louisiana, when oyster beds are crossed; from the Delta Migratory Water Fowl Refuge, when bird sanctuaries are involved; and from various levee boards and parishes.

Reconnaissance is by plane, routes being surveyed by aerial photography. Field survey crews move in by boat and marsh buggy. A recent line in Breton Sound was completely relocated to avoid oyster seeding beds.

To speak of ditching is actually a misnomer. First a pilot canal, then a flotation canal is dug by dragline, about 40 ft wide and 6 ft deep, to permit the "lay barge" to move in. The pipe ditch is dug to proper position in the bottom of the flotation canal. Then the lay barge, an articulated unit of two or three barges, moves in. A lay barge moving inland and crossing the Intracoastal Waterway is seen on page 35. Here again precoated pipe is being moved to the lay barge from a pipe coating yard. The laying procedure is similar to that already described.

Pipe coating procedures

Originally weight was applied to the pipe solely for the purpose of sinking it. Then enamel coating was applied to protect the pipe from corrosion and marine life. Later the two processes were combined. It was found best to apply the coating in a yard and to transport the coated pipe to the job site by barge. By this method, several inches of exposed pipe were left for the field weld. This gap in the coating had to be patched on the job after the weld was completed. Also the concrete had a certain rigidity which produced hairline cracks as the pipe slid off the lay barge.

Some of the objections to conventional concrete coating are the difficulties involved in moving the precoated pipe from coating yards, the care required in laying to avoid cracking as the pipe sags to the bottom of the ditch, and the inadequacy of the patched field coating in the joint.

A new development

A more recent development is the barge coating of pipe with a more flexible mastic weight-coat applied continuously at the point of lay. This method, known as Timcoat, was developed by Brig. Gen. P. H. Timothy (Ret.) and is now being applied by the Timcoat Corporation. By this process, the pipe is cleaned, welded, coated, wrapped and lowered into the ditch at the bottom of the canal in a continuous operation. See bottom photo, page 35.

The process consists in applying rubberized asphalt and barite aggregate, mixed in various proportions as determined by the weight desired and impregnated with shredded fiber glass, and then covering the pipe with an outer wrap of glass-mesh reinforcing.

The dry mix, consisting of sand and barite aggregates and limestone or barite filler and synthetic rubber and powdered asphalt, are continuously metered in predetermined ratios, mixed by a continuous paddle-type mixer, and loaded on the shuttle barge. Each shuttle barge holds sufficient dry mix for a day's operation, and two or three shuttle barges are used to assure continuous operation. Storage tanks are mounted on the shuttle barge to carry the day's supply of emulsified asphalt and fuel oil.

The coating barge has hoppers for a day's supply of materials. The dry mix is loaded from the shuttle barge and the emulsified asphalt is pumped into a storage tank on the rear of the welding barge, which is directly ahead of the coating barge. The dry mix is fed from the storage hopper together with the emulsified asphalt to the hot-mix machine, from which the mixture enters the coating machine. Chopped fiber-glass reinforcement is added during the final mixing process.

The hot mixture is extruded on to the pipe from the coating machine hopper under pressure, and the outer wrap of glass fiber reinforcement is spiraled onto the coated pipe under tension. The coated pipe is cooled immediately with a water spray.

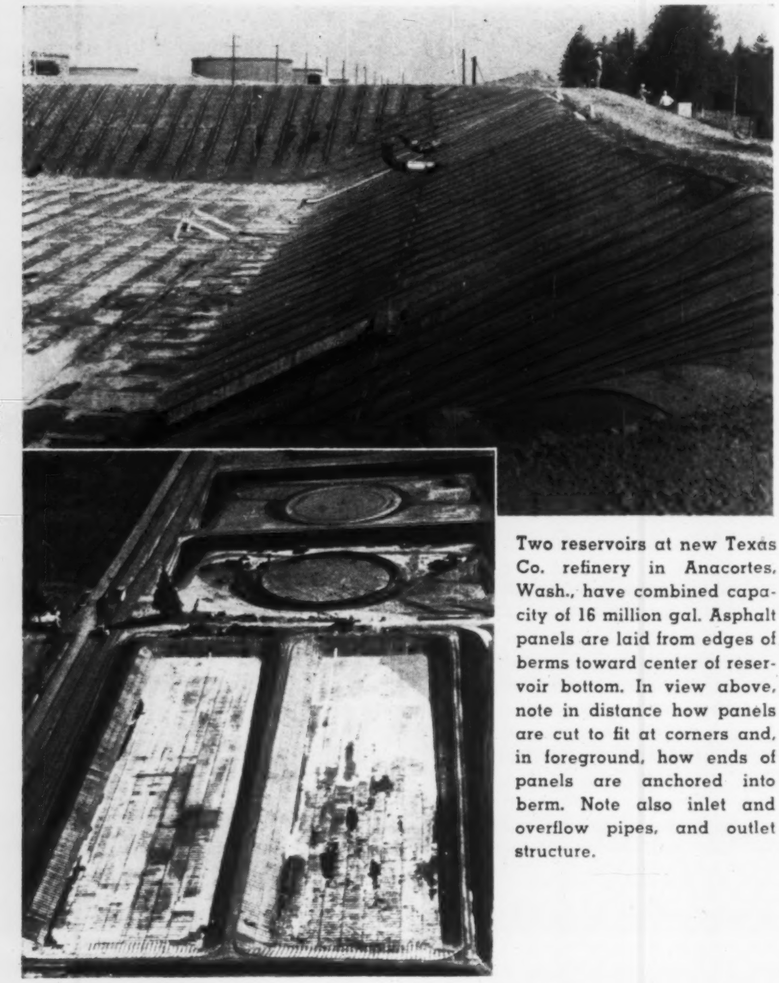
Swamp construction

As the pipeline moves inland from the open water through the marshland, it enters a wooded swamp area. Laying conditions are similar to those in the marsh except that the trees must be cleared to provide a right-of-way. Felling is done by a woodsman standing upright in a tiny pirogue. See photo on facing page. His balance is precarious, and only an expert can accomplish the trick. After the trees are felled the stumps must be pulled and the ditch cleared by dragline. The cost of the canal and ditch will depend largely on the terrain, and only slightly on the diameter of the pipe.

On to market

The pipeline, as it moves inland, encounters bayous, streams, and rivers, not the least of which is the Mississippi, which must be crossed with specially designed multiple-line crossings. There are many schools of thought on river crossing techniques. All agree that the lines should have sufficient flexibility to permit adaptation to changing bottom conditions.

The pipeline moves on out of marsh and swamp and north through the Piney Woods country of southern Mississippi, through modern compressor stations (at about 60-mile intervals), to meet the many needs for natural gas in the home and in industry.



Two reservoirs at new Texas Co. refinery in Anacortes, Wash., have combined capacity of 16 million gal. Asphalt panels are laid from edges of berms toward center of reservoir bottom. In view above, note in distance how panels are cut to fit at corners and, in foreground, how ends of panels are anchored into berm. Note also inlet and overflow pipes, and outlet structure.

LOUIS R. HOVATER, J.M.ASCE

Chief Engineer, Globe Linings, Inc.,

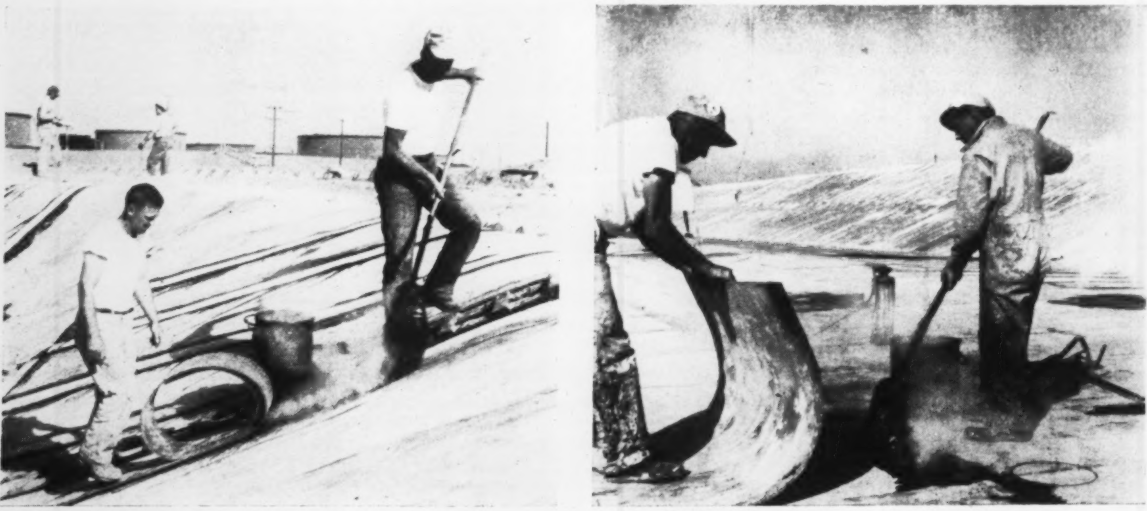
Long Beach, Calif.

Asphalt panels on compacted earth provide an economical reservoir lining for the storage of 16 million gal of water needed in the operation of the new refinery of the Texas Company at Anacortes, Wash. This plant, with a capacity of 40,000 bbl per day, is scheduled to start operation late this year.

The water storage is provided in two reservoirs, each about 680 ft long, 192 ft wide, and 11 ft deep. Slopes are 1 vertical on 2 horizontal. Each basin has an inlet pipe, an overflow pipe, a drain pipe, and an outlet structure and pipe. The two basins are separated by a berm 12 ft wide at the top. They are connected by a concrete equalizing structure and a pipe.

The engineer and constructor for the new facility specified asphalt panels ½ in. thick for the reservoir lining, to be laid directly on the compacted earth subgrade. The panels, which consist primarily of asphalt, the world's oldest water sealing material, impart no taste or odor to the water and are non-toxic. The lining is a long-lasting material made up of five fully waterproofing

Butt joints on slope are being sealed (below, left) with hot-applied asphalt adhesive. Joint overlay strips are rolled to a large diameter at the reservoir site for ease in placing. Below, right, lap joints on bottom of reservoir are being sealed with hot-applied asphalt adhesive. Note flexibility of panel.



ASPHALT PANELS for economical reservoir lining

components. The core is of asphalt, minerals and fibers. On each side of this core is placed a layer of asphalt-impregnated felt, and over this, on each side, an outside coating of hot-applied asphalt. The panels are made under pressure and heat to a standard width of 4 ft and to the desired thickness and length, in this case 20 ft. Weighing about 3 lb per sq ft, the 20-ft panels are delivered to the job site by truck from Long Beach, Calif.

Two types of joints were used for sealing—a lap joint and a butt joint. The lap joint, of 6-in. minimum width, was used to seal the 4-ft ends of the panels, and the butt joint, with an overlay strip 8 in. wide and 3/8 in. thick, to seal the 20-ft sides of the panels. The overlay strips are made slightly thinner than the panels so as to conform to them more readily during sealing operations. Care in making all joints is essential. When properly made, the joints are stronger than the panels, as tests and experience have shown.

For joint sealants, a combination of hot-applied asphalt adhesive and cold-applied asphalt mastic was used. First the joints were sealed with the hot-applied adhesive; then the exposed edges of panels and overlay stripes were pointed up with the mastic adhesive, thus providing a double seal.

The lining was sealed around pipes and concrete structures by attaching the panels to surrounding concrete shelves of 6-in. width provided in the plane of the lining. The panels were attached to the shelves by Ramset (explosive-inserted) fasteners and sealed with both types of adhesive. In addition, a panel collar was sealed around all openings through the lining to reinforce the panel-to-concrete seal.

This lining is flexible and will withstand seismic disturbances and take some subgrade settlement. However, like any type of reservoir lining, it requires an adequately compacted and prepared subgrade. All abrupt breaks and severe unevenesses in the subgrade should be smoothed out.

The earth subgrades of these reservoirs, after being compacted and shaped, were hand-raked to eliminate small rocks, clods of earth, and other unsuitable materials. Final compaction on the slopes was achieved by a steel-wheel roller pulled up and down by a tractor operating on top of the berms. A self-propelled tandem roller was used for final compaction of the bottoms.

To guard against the growth of any vegetation, the subgrades received an application of soil sterilant before the panels were placed. The sterilant, Polybor-Chlorate, manufactured by Pacific Coast Borax Company of Los Angeles, was applied in dry form at the rate of 8 oz per sq yd.

All materials for the lining were hauled into the reservoirs by truck and stockpiled near their final locations. Panels on the slopes were pulled into place by a crane operating on the berms. First the panels were placed on the slopes and then continued out across the bottom. The lining was closed in near the center of the bottom. In corners and around pipes and structures, the panels were cut to fit.

The lining was anchored at the top of each slope by bending the panels into the berm. A trench about 12 in. deep was dug at the edge of the berm by a crawler-type trencher. The panels were pulled into place and staked down using a minimum of two spikes and washers per panel. The spikes, 3/8 x 10 in., were driven through the panels into the compacted subgrade. After the panels were sealed together, their ends were buried by filling in the trench.

The combined surface area of both reservoir linings is about 280,000 sq ft. Lining required 24 working days. By building the reservoirs as one of the initial phases of refinery construction, the constructor has provided plenty of water for testing the many steel oil-storage tanks.

In the two reservoirs here described the Panelcraft molded asphalt panels, manufactured under a patent and license by Envoy Petroleum Co. of Long Beach, Calif., were installed by Globe Linings, Inc. (formerly Globe Engineering Co.) of Long Beach, Calif.

Final sealing operation is application of mastic adhesive at joints between asphalt panels.

PHOTOGRAMMETRY—

RAY A. KELSEY, J.M. ASCE,

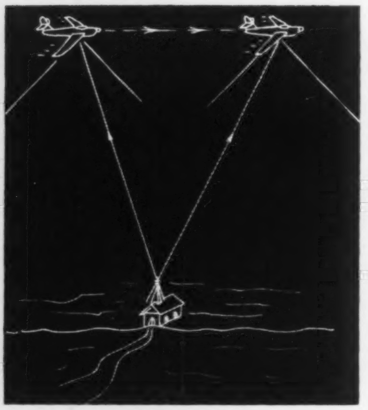


FIG. 1. Rays of light traveling up from church steeple are recorded on film at two different positions of airplane—that is, on overlapping photos.

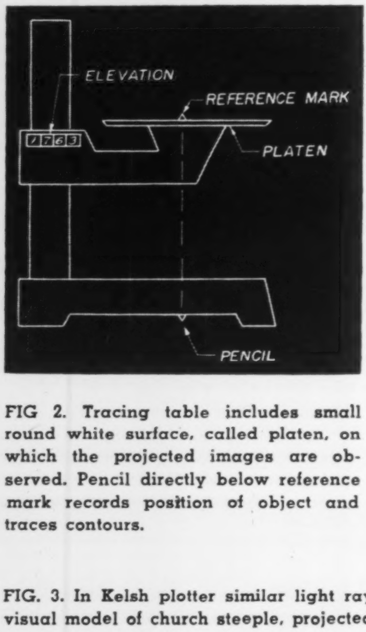


FIG 2. Tracing table includes small round white surface, called platen, on which the projected images are observed. Pencil directly below reference mark records position of object and traces contours.

Photogrammetry is a tool for engineers, not something to replace engineers. The photogrammetric method of producing a detailed precise topographic map is essentially that of performing horizontal and vertical measurements on a scale model of a portion of the earth's surface rather than on the earth itself—the traditional surveying method. By employing a scale model, photogrammetry makes it possible to do the map compilation in the office without regard to weather or other outside conditions, and the project can be divided up among a large number of workers. Dependence on the weather and many other sources of delay are thus avoided.

The scale model is constructed by optical methods, utilizing precise aerial photographs of the area concerned. The model is three-dimensional, and on it precise vertical and horizontal measurements can be quickly and conveniently made.

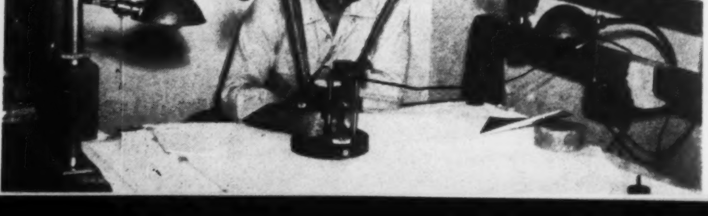
How is the optical scale model constructed and utilized for the compilation of a precise topographic map?

Consider for a moment an aerial camera in an airplane taking a photograph of some portion of the earth's surface. Notice the church steeple represented in Fig. 1. This particular feature on the ground is represented and recorded on the camera film by rays of light traveling up from the steeple through the camera lens to the film. The figure also shows the camera taking a second picture from a second point in space after the airplane has progressed in its flight. A second bundle of light rays from the church steeple on the ground enters the lens and records the same steeple on the second picture. The two photographs overlap each other. Each includes 50 to 60 percent of the other. Every object in the common area is therefore recorded twice, once in each photograph. The airplane flies along in a straight line while the camera takes pictures, each succeeding picture overlapping the previous one.

Now imagine for a moment that after the first two pictures have been developed it is possible to put each in a powerful projector and return it to the exact position up in the air where it was when exposed in the camera. If each projector is oriented in exactly the same way as the camera when the picture was taken, the photographic images of each picture will then leave the lens of the powerful projector as light rays along the same paths the original light rays traveled to enter the camera. The two bundles of light rays representing the church steeple will travel back to the ground and intersect at the exact true position of the church steeple. Assuming all these "if's" to be true, the situation that existed when the original photos were taken would be recreated. The actual church steeple could be removed and its position both horizontally and vertically would still be accurately marked by the intersection of the two sets of light rays. Obviously the horizontal and vertical position of every object on that part of the earth covered jointly by the two photographs is designated by the intersection of pairs of light rays in the same manner as a two-point intersection in surveying. The multitude of intersecting pairs of light rays thus form an optical scale model of the surface of the earth.

Since it is rather impractical to return the photographs to their original positions in the sky, the situation is recreated in miniature instead. Each of the aerial photographs is placed in a projector, the projectors are supported

FIG. 3. In Kelsh plotter similar light rays travel through film to intersect in visual model of church steeple, projected onto plotting table.



a few questions answered

Chief Engineer, Kargl Company, Inc., San Antonio, Tex.

on a frame above a table, and the pictures are projected toward the tracing table, shown in Fig. 2.

The photograph, Fig. 3, shows a reasonably priced map-plotting instrument called the Kelsh plotter. Notice the two projectors and the supporting frame and table. The table represents mean sea level or a plane parallel to it, and the light rays intersect in space above the table surface.

The optical or "photogrammetric" system of mapping may be outlined as follows:

1. **Taking overlapping photographs from the airplane.**
2. **Placing photos in table-mounted projectors.**
3. **Forming optical model of earth's surface by recapturing mutual orientation of projectors to make corresponding rays intersect in pairs.**
4. **Leveling the optical model with reference to the supporting table or the "measuring datum."**
5. **Obtaining exact scale of model.**
6. **Performing accurate elevation measurements.**
7. **Drawing planimetric features.**
8. **Plotting contours.**

The two projectors must be oriented so that they have exactly the same relationship to each other as existed between the two aerial pictures at the time of exposure. Only then will the corresponding light rays intersect in pairs to form a true model of that part of the surface of the earth photographed.

When the photographs are projected toward the table surface there are two images of every object, one image coming from each projector. The orientation procedure is accomplished by moving the projectors to match image pairs in order to bring corresponding rays into coincidence. There is a rather simple trial-and-error procedure for doing this in which the pairs of rays at five widely separated points in the model are observed and brought into coincidence in succession by utilizing the projector motions. (See *Multiplex Mapping*, Dept. of the Army Technical Manual 5-244, U. S. Government Printing Office, June 1954.) There are two methods, one using the motions of both projectors and the other using only one projector. For example, the second projector has six possible motions relative to the first. These motions are x, y, z, and x-tilt, y-tilt, and z-tilt. The tilts are rotations about the primary axes. The ground is the xy plane. The x-axis is parallel to the line joining the two projectors. The x-motion, which changes the distance between the projectors, does not affect the orientation procedure. Its only effect is to change the scale of the model. Only five motions are therefore necessary to accomplish the mutual orientation.

The orientation procedure is actually the graphic (or mechanical) solution of simultaneous equations. Since there are only five unknowns (the motions of the second projector relative to the first) then only five points in the model need be considered. In practice six widely separated points in the model are observed during the process. The sixth serves as a check on the orientation procedure. The model can be oriented by a good average operator in 5 to 10 minutes.

If the area photographed is perfectly flat (like the salt flats in Utah) then all the pairs of rays will intersect in the same horizontal plane. If the ground photographed has differences in elevation then different pairs of rays will intersect at different heights. It is possible to locate the point of intersection of the two sets of rays representing the church steeple, for example, by holding a piece of cardboard under the two projectors and moving it up or down to observe the images. At the point of intersection, the light rays coincide and only one church is seen. Above or below this point two images of the church appear. The images get further apart, the further the cardboard is held above or below the point of intersection.

Suppose the height of the cardboard above the table is measured and found to be 3 in. at the point where the two steeple images coincide. Suppose the height of the ray intersection of a water tower in the same model is measured in the same manner and found to be 4 in. The difference in elevation between the steeple and the water tower is therefore one inch. If the two projectors are 3 ft apart and the original pictures were taken 3,000 ft apart, then the scale of the optical model is 1 to 1,000. The one-inch difference in elevation between the steeple and the water tower in the model then becomes 1,000 in. (or 83.3 ft) on the ground.

Of course this elevation measurement will be accurate only if the model scale is correct and the surface of the model is level with respect to the table surface (or mean sea level datum) which was used in measuring the height of the ray intersection.

Since elevation measurements will not be accurate unless the optical model is level and the exact scale is known, photogrammetry is dependent upon surveying for ground control. Photogrammetry cuts the amount of field work in topographic mapping to a minimum, but it cannot and never was intended to eliminate the surveyor. Its speed is valuable in this enormous country of which less than 50 percent is accurately mapped.

In order to level the optical model, it is necessary to know the relative elevations of at least three identifiable points. (A theorem in geometry states that "Three points determine a plane.") The simplest and best way of leveling the model is to tilt the two projectors simultaneously as a unit so as to maintain their mutual orientation, that is, to keep all the pairs of intersecting rays intersecting. This can be done by tilting the supporting frame that holds the two projectors. The table top is assumed to be mean sea level.

Let us assume that a surveying crew has determined the actual elevation of the church steeple above sea level to be 310 ft and the actual elevation of the water tower to be 393 ft. The difference in elevation is 83 ft and the model must be tilted along a line joining the two features until the intersection point of the water-tower rays is 83 ft higher than those of the steeple. The model must then be tilted in a similar manner in a perpendicular direction using a third point of known elevation.

After the model has been leveled, the exact actual scale must be determined. This scale of course is the ratio between any distance measured in the optical model and the corresponding distance on the surface of the earth. The scale can be set or changed within instrumental limitations by varying the distance between the two projectors (the x-motion mentioned previously). If the two original photos were taken with an interval of 3,000 ft between them (that is, the airplane traveled 3,000 ft between exposures) and the two projectors are hung 3 ft apart in the frame, the situation is recreated at a scale of 1 to 1,000, or 1 ft on the model equal to 1,000 ft on the ground. Two points of horizontal control, or a line of known length, must be known and measured on the model to determine the exact scale.

The leveling and scaling of each and every optical model set up in a plotting instrument therefore requires at least three vertical and two horizontal control points. All needed control does not have to be obtained in the field however. Control from the first model (Pictures 1 and 2) can be extended to the second model (Pictures 2 and 3) since picture No. 2 is common to both models. Control from the second model can then be extended to the third model, and so on. Control can be extended long distances in this manner without sending surveying parties into the field.

This process is actually an instrumental triangulation. Accuracy decreases as the distance from the first model increases. There are, however, correction procedures, network adjustments and many other methods of utilizing the existing control to the fullest extent, just as there are in geodetic triangulation work. The process of extending control photogrammetrically is a whole field in itself. A great deal of research is being carried out at present involving adjustments by electronic computers in order to extend both horizontal and vertical control over long distances with great accuracy.

After the model has been formed so that corresponding pairs of light rays intersect in their correct positions, and after it has been leveled and its scale determined, the map compilation can begin. To measure the heights of the ray intersections more rapidly and accurately than is possible with a piece of cardboard and a scale, a tracing table is used, as shown in Figs. 2 and 3.

The tracing table has a small round white surface called a platen on which the projected images are observed. This platen may be moved vertically up and down by means of a micrometer-screw arrangement. Its vertical travel is measured directly to the nearest 0.1 millimeter (0.004 in.). At the center of the observing platen is a small reference mark—usually an illuminated dot. The micrometer screw is turned to bring the platen and its mark up or down until the two projected images merge, indicating the ray intersection. The height of the platen surface can then be read from the micrometer. For purposes of plotting the features, the tracing table has a pencil very accurately placed beneath the reference mark on the center of the platen. The pencil is lowered or raised to draw only when desired.

The exact location and elevation of the church steeple can be determined by raising or lowering the platen until the steeple images merge, moving the tracing table until the reference mark is exactly on the image, then lowering the pencil and recording the position of the steeple, and reading the micrometer to get the elevation. The position of the steeple horizontally and vertically is thus determined in the office without actually visiting the church itself. Since the pencil is located exactly underneath the platen reference mark, it plots the orthographic projection of the image point regardless of the height of the platen. (The line connecting the platen reference mark and the pencil is perpendicular to the measuring datum, the supporting table.)

Stereoscopic viewing

The method of locating the intersection of the pairs of rays by observing the merging of the images as the tracing-table platen (or even a piece of cardboard)is moved up and down in the optical model is excellent for demonstration but slow and cumbersome in practice. The method actually used in plotting maps is to observe the model stereoscopically, making the photographed area of the earth's surface appear in three dimensions, the hills standing up and the valleys depressed, just as they would appear from the air.

For an object to be seen truly in three dimensions, each eye must see its own image, each image taken from a slightly different point in space. The following simple experiment makes the principle clear. Hold your finger at arm's length and look at it first with one eye and then with the other. You will notice that the left eye sees slightly more of the left side than the right eye. The stereoscopic theorem has two parts: (1) Each eye obtains its own picture or view of the same area or object, and (2) each picture or view is from a different point in space. (A one-eyed person cannot see objects truly in three dimensions.) The two separate aerial photos which were placed in the plotting instrument thus fulfill part of the theorem in that each was taken from a different point in space.

To satisfy the second part of the theorem, the left eye of the plotting operator must be restricted to see only the left picture and the right eye only the right picture. One of the simplest ways to do this is to project one picture with blue light and the other with red. Then if the observer wears a pair of spectacles with one red lens and one blue lens, the light and filters provide mutual exclusion and each eye sees only the picture intended for it. The brain receives the two slightly dissimilar images and fuses them into a single composite three-dimensional sensation. This method of using red and blue filters to separate the pictures in viewing stereoscopically is called the anaglyph method of satisfying the stereoscopic theorem. Some movies and illustrations in magazines employ the anaglyph method.

When the model is observed in this way, "in stereo," the reference mark or illuminated dot appears to float in the air if the tracing-table platen is above the ray intersection and to sink beneath the surface of the ground when the platen or piece of cardboard is moved below the ray intersection. When the platen is exactly "on" a ray intersection, then the dot appears to rest on the ground. The common term for the illuminated reference mark is naturally "floating mark" or "floating dot."

The operator of the stereoscopic plotting instrument wearing the red-blue glasses sees the projected image of the earth's surface in three dimensions. He has the sensation of looking down on the earth from far up in an airplane. If the old Chinese adage about a picture being worth a thousand words is true, then a stereo picture is surely worth ten thousand words. Drainage systems can be quickly followed from beginning to end. The whole lay of the land is seen at a glance.

The sensation of observing a good clear stereo model and floating mark in a plotting instrument for the first time is one never to be forgotten. It is well worth one's while to make a special effort to see a stereo plotter in action.

Planimetric detail can be drawn directly on a sheet of paper merely by following the features (roads, streams, etc.) with the reference mark of the tracing table while the pencil traces them in correct position. The whole process of plotting a map in a stereoplotting instrument such as the Kelsh or multiplex is somewhat like pushing a kiddie car (the tracing table) around the table, following a road or stream with the floating dot, while the pencil traces the details on the paper. As one moves around the three-dimensional model tracing a planimetric feature

Questions and Answers

1. Where can I get aerial photos of an area for study at a reasonable price?

Answer: Order prints or enlargements from the Commodity Stabilization Service, Performance Division, U. S. Dept. of Agriculture in Washington, D. C., for the eastern half of the United States and Salt Lake City for the western half. Write for order blanks. A 9-in. x 9-in. contact print costs about 65 cents.

2. Where can I get information on what parts of the United States have already been photographed and who has the original negatives?

Answer: Write Map Information Office, U. S. Geological Survey, Washington 25, D. C., and ask for the map, "Status of Aerial Photography in the United States." (A map, "Status of Topographic Mapping in the U. S." is also available.)

3. I have some stereo pairs of aerial photographs. Can topographic surveys be compiled from these and thus save me the cost of flying, etc.?

Answer: Yes, but as the altitude is fixed, the contour interval is also.

4. What factors affect the cost of a photogrammetric survey?

Answer: The cost of a photogrammetric topographic survey is directly related to the contour interval and the area involved. (Moral: Don't ask for 2-ft contours if 5-ft ones will do.)

5. Will the use of a camera of longer focal length enable a smaller contour interval to be plotted?

Answer: No, the contour interval possible is directly related to the altitude of the camera at the time of exposure. Changing the focal length for a given altitude does not affect the permissible contour interval.

6. What is it that prevents measurements from being made accurately on aerial photographs directly?

Answer: Aerial photographs have image displacements due to the following: tilt of camera, ground relief, camera lens distortion, film and paper distortions. These factors are corrected or compensated for in the stereoscopic plotting instruments.

such as a road or a stream pattern, the floating dot must be kept on the ground by moving the platen of the tracing table up and down, so that the true orthographic position will always be recorded.

The last operation is the all-important one of plotting topographic features—recording the lay of the land. Topography is usually represented by contours (lines of equal elevation) and spot elevations. In transit-stadia work contours are developed by interpolating from the multitude of spot elevations determined. In the photogrammetric method, contours are drawn directly as lines of equal elevation. The method is possible because the operator sees the model in three dimensions and uses the floating dot as a moving, measuring reference mark.

As previously described, the tracing table platen containing the reference mark or floating dot can be moved up and down and its height above the supporting table measured by a built-in micrometer. The procedure in plotting contours is to adjust the platen up or down until the micrometer is set at some particular contour interval. The platen is then locked so that it will remain in this position and the whole tracing table is moved until the floating mark rests on the surface of the ground. Consider a cone-shaped hill or mountain, for example. When the floating mark hits the side of the hill, then a complete closed contour can be drawn by dropping the pencil point and moving the tracing table around the hill, keeping the floating dot always in contact with the ground. After the contour at a particular level has been completed, the height of the tracing table platen is changed to the next desired contour and the procedure repeated. Since the contours developed during stereo-plotting are continuous, they perhaps have even greater accuracy than those interpolated from transit stadia-readings.

National standards of accuracy for topographic maps were adopted in 1942. These specifications state that 90 percent of the elevations interpolated from contours shall be accurate within one-half the contour interval and 90 percent of all well-defined planimetric features shall be in true position within 0.02 in. on the published map.

The accuracy of the photogrammetric method of map making depends upon the precision with which measurements are made on the optical model of the earth's surface. This varies with the plotting instrument. There are many different types, both domestic and foreign, and prices range from two or three thousand dollars to as high as fifty or sixty thousand depending on the capabilities.

In the Kelsh plotter, for example, the projection distance is a nominal 760 millimeters (mm), which represents the flying height of the airplane. A good average operator can measure with the micrometer of the tracing table directly to 0.1 mm. Spot elevations can therefore be measured accurately to 1/7,600 of the flying altitude.

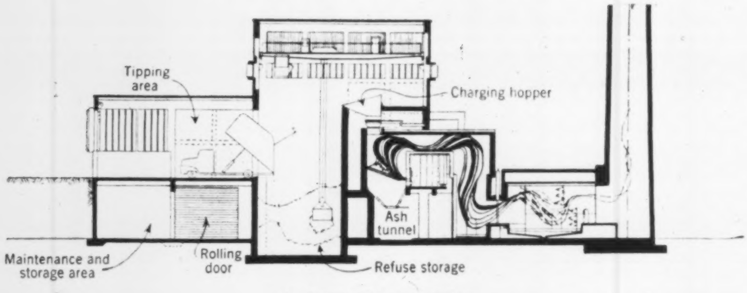
A good average operator can accurately plot contours which are separated by 0.5 mm in the optical model of the Kelsh plotter, or about 1/1,500 of the flying altitude. Thus 5-ft contours can be plotted in a Kelsh plotter from photography flown at an altitude of 7,500 ft. To obtain 2-ft contours, it is necessary to fly at 3,000 ft, and a great many more photographs and more ground control are necessary.

Mapping to be performed by photogrammetric methods should be governed by detailed specifications to control its quality just like any other type of civil engineering work. The "Specifications for Aerial Surveys and Mapping by Photogrammetric Methods for Highways" (U. S. Government Printing Office, 55 cents) is an excellent reference work for the preparation of such detailed specifications. It should be emphasized that specification requirements must not be copied blindly. There are definite reasons for each requirement and these requirements vary according to the purpose of the map, the type of country, the type of plotting instrument to be used, and many other factors.

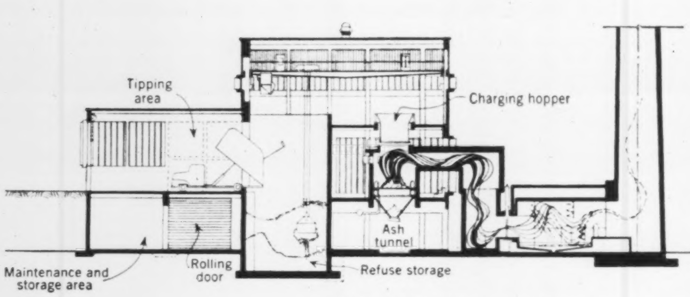
Specifications tailored exactly to fit a particular mapping job insure the lowest possible costs. Each unnecessary provision inserted in a contract increases the cost. Reliable photogrammetric companies have been heard to exclaim, "These people and their unnecessary spec provisions! They won't let us save them time and money."

If in doubt about photogrammetric techniques or methods (or almost any matter relating to photogrammetry) consult an authority. The American Society of Photogrammetry, 1515 Massachusetts Ave., N. W., Washington 5, D. C., has a technical information committee set up to answer questions relating to all aspects of photogrammetry. Its Manual of Photogrammetry ($7.50) is a useful publication.

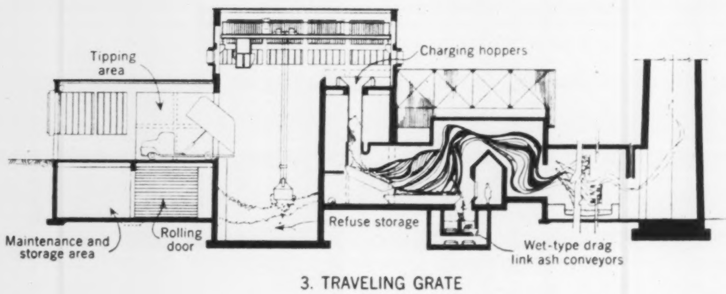
Photogrammetry is not a trick or a short cut. It might be briefly described as a method of preparing and measuring a model of an object rather than the object itself. Thousands of projects (including such large ones as the Pennsylvania Turnpike) have demonstrated the advantages gained by using photogrammetry for such items as preliminary reconnaissance, location studies, and earthwork computations. Photogrammetry is a tool which should be used by the civil engineer like any other scientific tool, that is, when it is advantageous considering the results desired. Used under correct conditions by competent personnel it offers savings in both time and money.


Tipping area
Charging hopper
Ash tunnel
Maintenance and storage area
Rolling door
Refuse storage

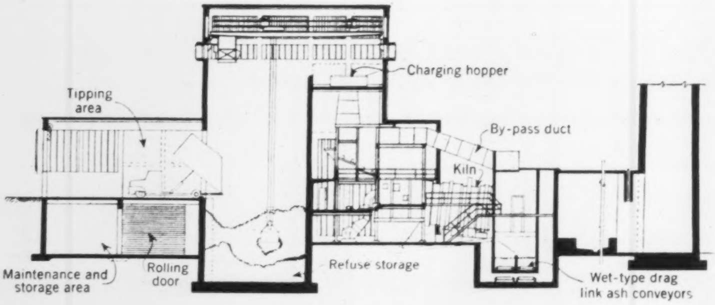
1. RECTANGULAR GRATE


Tipping area
Charging hopper
Ash tunnel
Maintenance and storage area
Rolling door
Refuse storage

2. CIRCULAR GRATE


Tipping area
Charging hoppers
Refuse storage
Maintenance and storage area
Rolling door
Wet-type drag link ash conveyors

3. TRAVELING GRATE


Tipping area
Charging hopper
By-pass duct
Kiln
Refuse storage
Maintenance and storage area
Rolling door
Wet-type drag link ash conveyors

4. ROTARY KILN

FIG. 1. Four types of furnaces are predominant in storage-pit and crane incinerators. Their relative annual costs are compared in the graph, Fig. 2.

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Such terms as trash and refuse disposal carry a distasteful connotation to the public, and hence many communities ignore this problem—or would like to. But time is running out. If they haven't yet sought a more efficient and attractive method of refuse disposal than the old town dump, many communities soon will be forced into decisive action, if only because of population growth and increasing land values. They will find that incineration is the only practical long-term solution, no matter what their yardstick.

Indeed, in a decade in which a large percentage of individual income is being spent on fashionable homes and labor saving devices, and in which large amounts of money are being spent for new schools, new roads, and new utilities, it is paradoxical to find that, in a number of states, over 90 percent of the communities still dispose of their refuse in an open dump. The conditions created by these dumps—smoldering fires, odors, rats and insects—depreciate property values and threaten health standards. Though these nuisances and health hazards may be improved by periodically covering the dump with soil, they seldom are completely eliminated.

Disposal by land fill

Disposal in a sanitary land fill (Fig. 3) generally is considered more satisfactory than an open dump. In addition, it can be a means of reclaiming land of low elevation. In many respects, the facility is similar to a covered dump. A trench is excavated, used as a dumping area until full, and then covered with soil. The refuse is deposited in units, so to speak, and if ignited by spontaneous combustion, burns only until the affected unit is consumed.

Unfortunately this method requires a specific type of land area—one that is located within reasonable hauling distance of the population center, and which has a well-drained, sandy soil. If soil conditions are not favorable, then suitable cover material must be hauled from a borrow pit some distance away, and this greatly increases the cost of operation.

Unfortunately too, the amount of equipment needed to maintain a sanitary land fill represents a substantial

Choosing the right incinerator

investment. A crane and dragline bucket, a bulldozer, and at least one truck are required to excavate trenches, cover rubbish, and haul the fill. Because of this expense, the land fill often becomes the target for economy drives and gradually reverts to an open dump.

Theoretically, a method called "composting" can be used for rubbish disposal when amounts are not excessive. In principle, it's attractive. Rubbish and garbage are ground up and left to be reduced by controlled bacterial action. The speed of this action can be increased considerably over that of the common backyard compost pile. However, the few installations now in operation in this country have not proved satisfactory, and the widespread application of composting must await the results of research now in progress.

Still another method of disposal, frequently used by large metropolitan centers, is to tow the refuse out to sea in large bottom-dump barges or scows. However, this method is limited to communities that are directly on the ocean, and because of cost, it is usually considered a supplementary rather than a primary means of disposal.

Incineration, a better answer

Eventually, then, communities of any size discover that incineration is the best and most practical method of refuse disposal, even though the plants are not inexpensive. But where should the plant be located? How can it be financed? How should it be designed? And which type of furnace should be employed?

Most property owners shudder at the thought of having an incinerator in their neighborhood. They recall the odor, scattered debris and unsightly appearance associated with the plants of twenty years ago. But such conditions do not accompany modern incineration, provided the plant has been properly planned and engineered. Buildings can be designed and constructed to blend in with the structures in neighboring areas. Odors and fly ash can be controlled. Dumping operations can be performed indoors in confined areas. So, while no one wants an incinerator in his back yard, today there is more latitude in locating it within a community than previously was the case. Some of the factors to be considered are given in the accompanying box.

Besides site considerations, there are many financial and technical aspects of design that must be taken into account. Operating as well as initial costs, public versus private funds and operation, the type of refuse that must be handled, the volume of ashes that can be expected, and even smog or other climatic conditions, should be studied and evaluated. In fact, few structures require more comprehensive surveys and studies on a community level than incinerators.

In many communities, where an incinerator is urgently needed, bond issues for schools and other needed improvements have exhausted the city's capacity to obtain funds for new projects. Fortunately some states recently have enacted laws permitting a private contractor to build and operate an incinerator under a long-term agreement with the city. In one such instance, a city received an offer from a contractor to take over refuse collection, and construct and operate an incinerator for the same annual expense now borne by the city. In addition, the contractor would, at the end of twenty years, give the plant to the city.

By-products of incineration often can be utilized to offset part of the construction and operating costs. Waste-heat boilers, besides cooling the gases for fly-ash removal, can be utilized as steam generators for power or for heat. Waste metals, such as tin cans, can be salvaged from the ashes whenever quantities or scrap-metal prices are high enough to make this worth while. With good operation and a thorough removal of scrap metal, the ashes become valuable as fill. These and other factors should be studied when considering the merits of an incinerator.

Which type is best?

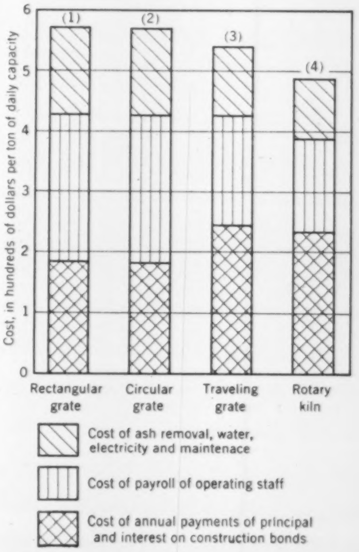
Two principal types of incinerators are being used today—the floor-dump type and the storage-pit and crane type.

Most older plants are of the floor-dump type. In a typical installation, the refuse collection truck is driven onto the floor and its contents dumped near the charging hole of the furnace. The refuse then is fed into the furnace manually or with a small bulldozer.

Limitations inherent in the floor-dump incinerator have made it impracticable in many communities. Generally it is considered only when capacities are below 80 tons a day and even then it is often deemed inefficient. Relatively small floor areas for storing refuse, high ceilings to permit dumping of packer-type trucks, and unsightly piles of rubbish, besides the time-consuming task of maneuvering large collection trucks around the unloading area, are strong arguments against its use.

With an incinerator of the floor-dump type, rubbish must be burned at the rate it is delivered. But with a storage pit, the average burning rate is the controlling factor, and fewer or smaller furnaces may be satisfactory. The constant attendance needed to operate a floor-dump incinerator efficiently is also a disadvantage. Personnel must charge the furnace, stoke the fire, and remove the ashes. On the credit side is one big advantage—lower initial costs for equipment. This is the reason why many communities favor the floor-

FIG. 2. Annual costs, broken down into three categories, are compared graphically for four types of furnaces sketched in Fig. 1.



dump type. In operation, some of its disadvantages can be overcome by carefully planned collection schedules and the use of proper auxiliary equipment.

The storage-pit and crane type of incinerator has, until lately, been used almost exclusively in plants having capacities of 200 tons or more a day, where rapid handling of a fleet of collection trucks is necessary and where two or more shifts per day are required. Recently, however, some towns have installed this type for smaller units. Ease of handling, greater flexibility, and the advantages of storage overcome the cost considerations.

Storage space sufficient to operate the plant at full capacity for at least one day usually is provided in this design. An operator using an overhead crane with a grab bucket transfers wastes from the storage pit to charging hoppers located over the center of each furnace. As the refuse is fed into the furnace, it is ignited by radiant heat from the hot refractory walls. Air is supplied through the grates and, for overfire air, through openings in the furnace walls. Furnace temperatures are held between 1,400 and 1,800 deg F.

Supplementary oil burners are often installed in the furnace to keep temperatures above 1,200 deg F when trash and refuse are wet. Below this temperature, obnoxious odors and air pollution may be created by incomplete combustion.

Normally, first cost is the only limitation to installation of an incinerator of the storage-pit and crane type. However, if costs are figured on a long-term basis, and operating and maintenance expenses are considered as well, the crane-type incinerator often proves the less expensive of the two.

Factors to consider in selecting a site

1. Nearness to population center that is to be served. The closer the plant, the less the expense of collection. Zoning laws and effect on property may limit the choice.

2. Street or road access to the site. The plant should be on or near main roads so that collection trucks do not have to travel over residential streets when entering or leaving the incinerator.

3. Size of site. The tract should contain at least four acres, with additional space for ash disposal if necessary. Driveways within the site should be long enough so that trucks can queue up during peak hours.

4. Topographical features. A plant located on the side of a hill often costs less to build because fewer ramps are required. When the plant is on the leeward side of built-up areas, the need for equipment to remove fly ash diminishes.

The furnace is the heart of an incinerator. On it depends the amount of rubbish that can be burned in a given time, the architecture of the building, and to a large degree, the cost of installation.

Stated simply, a furnace is a device for converting solid combustible matter into gas. The amount of smoke and partially burned material emitted from the chimney is controlled by designing the furnace so that adequate time, temperature, and turbulence make combustion as complete as possible. The refuse is received, ignited, and burned in an ignition chamber. Here the combustible material is reduced to ashes and volatile, burning gases. The volatile gases pass into a second combustion chamber where the necessary turbulence mixes them with air for complete combustion. Fly ash can be removed in expansion chambers, wet-spray scrubbers, cyclones or electric precipitators.

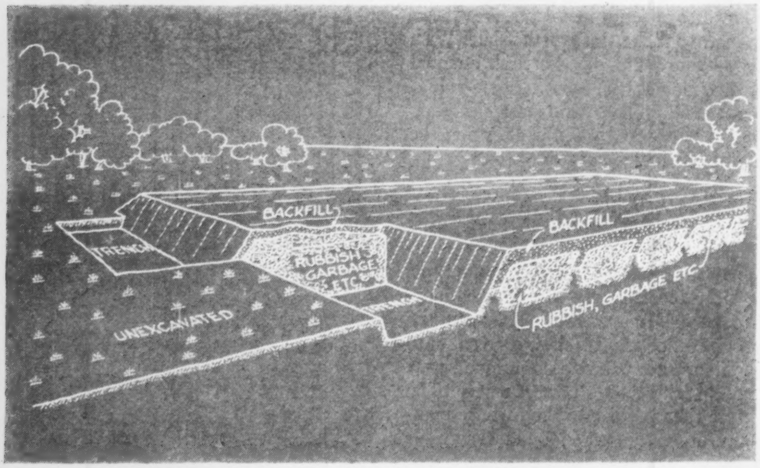
Four types of furnace are in use: (1) the rectangular grate, (2) the circular grate, (3) the traveling grate, and (4) the rotary kiln. See Fig. 1. Each has different characteristics—advantages and limitations. Each requires different supplementary equipment, and each involves different investment, operating and maintenance costs. Normally the rectangular-grate and circular-grate types are used when capacities will be 150 tons a day or less per unit. The traveling grate and rotary kiln are used for installations burning up to 300 tons a day per unit. A battery of rectangular or circular-grate furnaces of course can be used to obtain the high capacities obtained by fewer units of the traveling-grate or rotary-kiln type. A distinct advantage of traveling-grate and rotary-kiln furnaces is continuous charging and continuous removal of residual. In the other types, these are intermittent operations.

The cheapest incinerator in initial cost is not necessarily the least expensive in average annual outlay. This may be seen from the graph of Fig. 2. The rectangular-grate and circular-grate types cost less to build but more to operate than the traveling-grate and rotary-kiln types. The more complete combustion obtained and smaller operating staff required for the rotary-kiln type make it the least expensive in overall costs. The graph is based on a 300-ton-per-day plant with construction financed by a 30-year bond issue carrying an interest rate of 3½ percent.

Other necessary furnace equipment includes a damper for controlling the draft, and a chimney. The latter may vary in height from 75 ft in the smaller units to 200 ft or more in the larger ones.

Unfortunately there is no one formula that can be applied to give the best type of incinerator installation for all communities. Each must be investigated. Studies must be thorough to obtain proper operating methods, the best available site, and the most satisfactory financing. Construction costs alone make it evident that the selection should not be made by amateurs. In this field, as in many others, careful planning is the first requisite to economy, efficiency and a good installation.

FIG. 3. A sanitary land fill, in addition to requiring a substantial amount of equipment to maintain it, should contain an area of 0.75 to 1.5 acres per year for a population of 10,000 people.



Prestressed pressure pipelines for Athens Aqueduct

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Philadelphia, Pa.

In the 25-mile extension to the Athens aqueduct now nearing completion, two sections of prestressed concrete pressure pipe have been incorporated where pumping is required—one 12,800 ft long, the other 4,200 ft. This pipe is also used for a 22,000-ft siphon crossing a valley. The methods adopted for manufacturing, transporting, placing and testing this pipe of 52-in. diameter are of considerable interest. See Fig. 1.

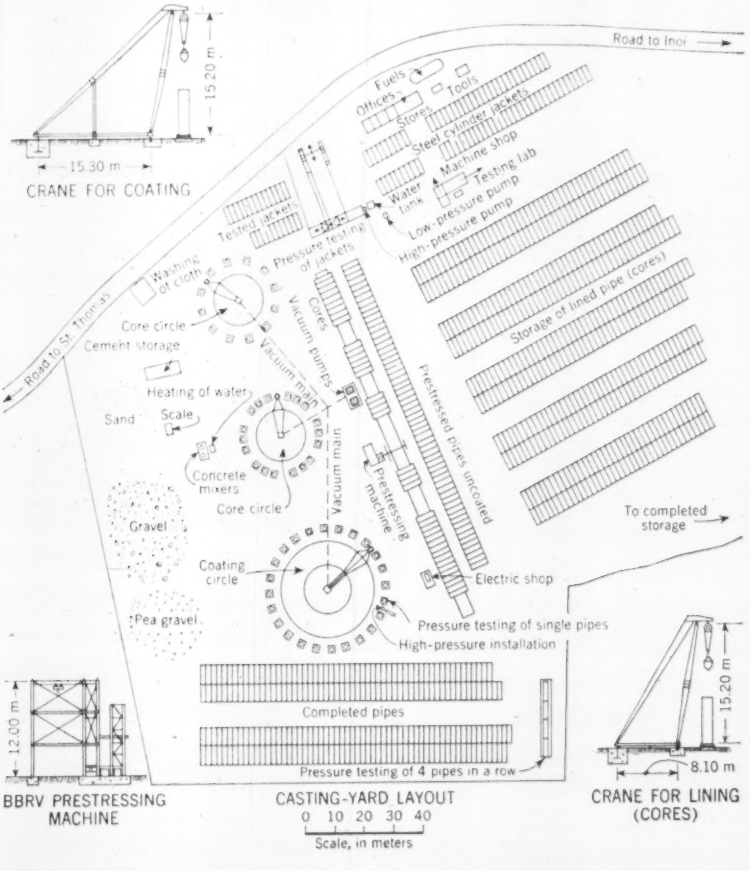
Athens, the capitol of Greece, has a present population, including environs, of over 1,300,000. To meet the needs of its growing population and the rising per capita consumption, the city has several times enlarged its water supply facilities.

After World War I the problem was solved by the erection of a gravity dam 140 ft high 20 miles north of Athens, near Marathon, the famous ancient battlefield. (This work was described by R. W. Gausmann, M. ASCE, in the article, "Athens Builds Modern Water Works," in Civil Engineering for January 1933, p. 1.) Next, this source of supply was reinforced by building a 20-mile aqueduct to convey additional water by gravity to Marathon Lake from the Mount Parnis drainage area. See map, Fig. 2. When the supply still proved to be insufficient, it was decided to extend this aqueduct further north to Lake Yliki—the project here discussed. With this extension, Athens will secure an additional 100 million cu meters (about 81,000 acre-ft) per year, which will cover the requirements of the capitol for the next 25 years.

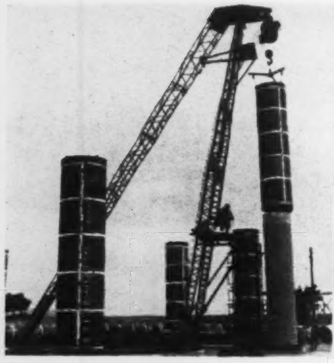
The aqueduct from Lake Yliki to Viliza (Fig. 2), 25 miles long, starts at Mouriki with a pumping main 12,800 ft long which elevates the water 100 m (328 ft). From there, the water flows by gravity for 8 miles in an open canal lined with concrete, crosses some hills in a tunnel 1.5 miles long and continues for another 5 miles in an open canal to the ancient Acropolis of Tanagra. It then crosses the Assopos Valley in a siphon 22,000 ft long, at the end of which a second pumping station elevates the water 75 m (246 ft) through a pumping main 4,200 ft long.

The pressure sections will consist of twin prestressed concrete pipelines each with a diameter of 1.32 m (52 in.) and

FIG. 1. Layout of casting yard provides for four main operations: (1) testing of steel cylinder jackets on arrival; (2) placing of concrete core in jackets, at two upper circles; (3) prestressing of lined pipe, near center; and (4) placing of outside concrete coating on pipe, large lower circle. In photo, above, yard is seen from opposite direction, with completed pipe in foreground.



15.20 m
15.30 m
CRANE FOR COATING
Road to Inoi
Fuels
Offices
Stores
Tools
Steel cylinder jackets
Machine shop
Testing lab
Water tank
Low-pressure pump
High-pressure pump
Tested jackets
Pressure testing of jackets
Washing of cloth
Road to St. Thomas
Core circle
Cement storage
Cores
Vacuum pumps
Vacuum main
Storage of lined pipe (cores)
Prestressed pipes uncoated
Heating of water
Sand
Scale
Concrete mixers
Core circle
Vacuum main
Prestressing machine
Gravel
To completed storage
Coating circle
Electric shop
Pea gravel
Pressure testing of single pipes
High-pressure installation
Completed pipes
Pressure testing of 4 pipes in a row
12.00 m
BBRV PRESTRESSING MACHINE
CASTING-YARD LAYOUT
0 10 20 30 40
Scale, in meters
15.20 m
8.10 m
CRANE FOR LINING (CORES)



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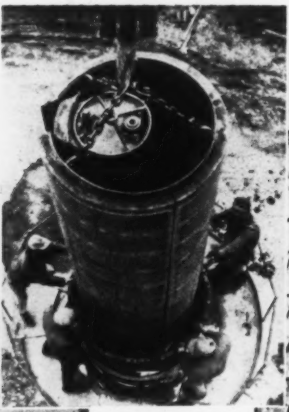
2



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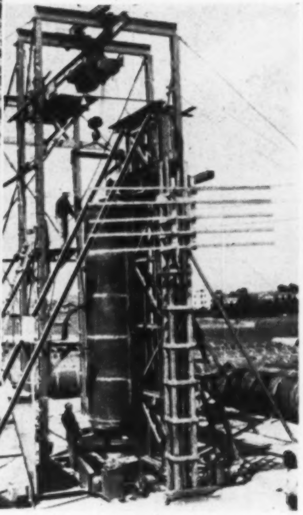

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a total capacity of 3.25 cu m per sec (115 cfs). One of these twin lines is being built now and the second is to be built some time in the future.

The pressure sections are made up of individual lengths of prestressed concrete pipe 52 in. in diameter and 20 ft long. The thickness of the internal concrete lining, which is referred to as the "core," is 3½ in., and that of the outside concrete cover 1⅜ in. Between these is the cylinder jacket, which is of 16-gage steel. This pipe was designed in accordance with the specifications of the American Water Works Association.

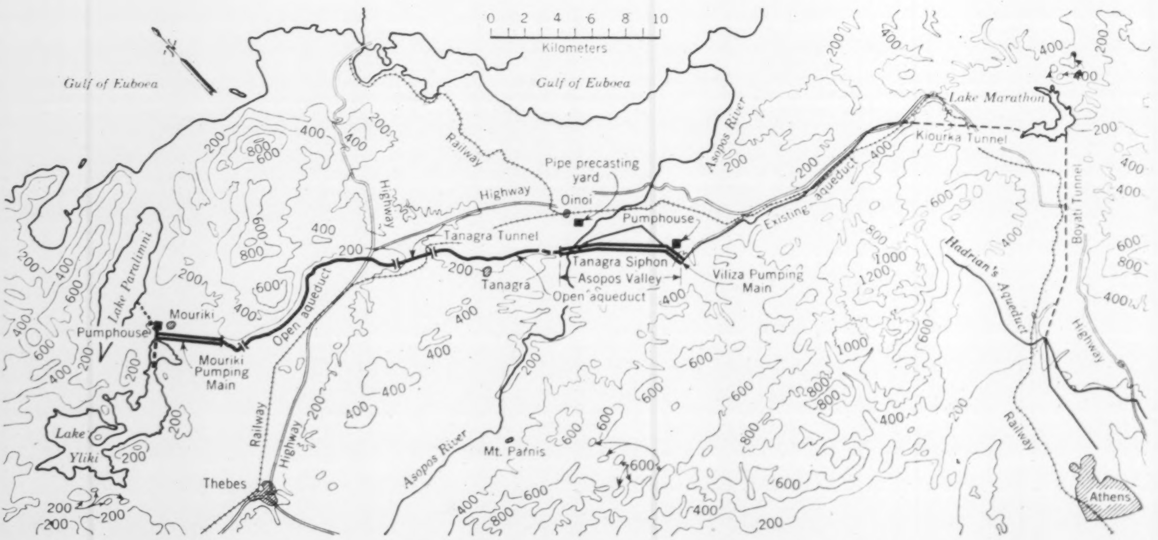
The pipe is prestressed circumferentially with high-tensile-strength cold-drawn wire 5 mm (0.197 in.) in diameter, at pitches varying in accordance with the pressure requirements. The joint between individual lengths is secured by a self-regulating Flexlock rubber gasket fitted between a steel bell and a steel spigot welded at the ends of the steel cylinder jacket. See Fig. 3.

The static head for the Mouriki Pumping Main is 328 ft, and for Viliza Pumping Main 246 ft, and for the Tanagra Siphon 282 ft. The pumping mains are designed for a water hammer equal to 100 percent of the static head and will be tested at twice their static pressure (660 ft and 500 ft respectively). The siphon, however, will be tested at 140 percent of its static pressure, that is, at 400 ft.

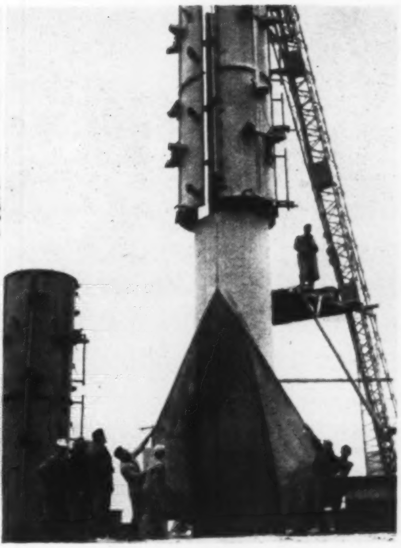
The total pipe length of 39,000 ft consists of 1,950 individual 20-ft sections. The contract, awarded in January 1957, calls for the delivery of all the pipe by the fall of 1958, that is, in a period of 18 months.

All plant, forms and equipment were ordered and delivered to the site by the end of July 1957, and the first pipe core was cast on August 31, 1957. The construction program calls for a daily output of 12 pipe lengths, and it is anticipated that the project will be completed on time.

The pipe casting yard was located near the longest section of pressure pipeline, near the railway station of Oinoi, about 40 miles from Athens. It was decided to have the steel cyclinder jackets made in Athens and Piraeus and transported to the casting yard.


0 2 4 6 8 10
Kilometers
Gulf of Euboea
Gulf of Euboea
Railway
Highway
Highway
Pipe precasting yard
Oinoi
Tanagra Tunnel
Pumphouse
Tanagra Siphon
Asopos Valley
Open aqueduct
Tanagra
Viliza Pumping Main
Asopos River
Existing aqueduct
Lake Marathon
Kiourka Tunnel
Boyati Tunnel
Hadrian's Aqueduct
Highway
Railway
Athens
Lake Paralimni
Mouriki
Pumphouse
Mouriki Pumping Main
Open aqueduct
Lake Yliki
Thebes
Railway
Highway
Asopos River
Mt. Parnis

5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First casting step is lining of steel cylinder jackets, photos (1), (2) and (3). In (1) jacket is lowered over inside vacuum-processing form by specially designed circular crane. Next "corset" and working platform are lowered over outside of jacket (2). Forty minutes after concrete of 3½-in. thickness has been placed, inside form is pulled up, past men standing on working platform, as seen in (3). After pipe cores have cured two weeks, prestressing wire is wound around them by machine shown in (4). Then comes application of outside concrete coating 1⅜ in. thick. In (5), clean nylon jacket is lowered over prestressed pipe length to act as form lining. Steel vacuum form with working platform attached, seen at left, is next lowered, and concrete is placed. After vacuuming for 30 min., form is removed and nylon peeled off, (6), to be washed and reused.

The jackets consist of rolled sections of 16-gage steel sheet welded together with automatic welding equipment. The bells, made of steel plate $\frac{5}{16}$ in. thick, are 8 in. long, and the spigots, of $\frac{7}{32}$-in. plate, are the same length. Both are rolled and welded into rings, then "expanded" to exact size in a special machine. The automatic welding equipment attaches them to the ends of the 16-gage steel cylinder jackets.

Initial shop testing of the jacket welds was carried out by painting the welds on the outside with whitewash, then brushing the inside with kerosene. Where the kerosene went through it would show as an oily mark on the whitewash. Defects thus discovered were repaired in the shop.

The layout of the casting yard, an important feature, is shown in Fig. 1. When the steel jackets arrive by truck at the casting yard, the first step is to test them at water pressures in accordance with the specifications of the American Water Works Association. All defects in the welds were noted, repaired, and the jackets tested again until all the welds were watertight.

The vacuum process is used for casting both the core and the outside covering of the steel jackets. Vacuum is produced by two Fuller rotary vacuum pumps of 1,100 cfm.

For placing the cores in the jackets, two circles were laid out. See Fig. 1. In each a circular crane in the center stands the jackets in a vertical position on mechanical base rings arranged around it in a circle. Each of these two cranes, manufactured in Piraeus, is equipped with a 7.5-ton electric hoist.

After prestressing, the pipe is moved to a third circle (Fig. 1) where the outside 1⅜-in. concrete cover is put on to protect against corrosion. Here 24 base rings are served by a circular crane with a 10-ton electric hoist.

In casting the pipe core, the steel jacket acts as the outside form. The inside form is a vacuum processing unit manufactured by Ettlingen Maschinenfabrik of Germany, and made collapsible for easy withdrawal. One is used in each of the lining circles shown in Fig. 1.

With 12 machined cast-iron base rings per circle and one vacuum form, one crane can cast 6 pipes per circle per day and remove them for curing 48 hours after casting. By adding 6 base rings to the second circle (Fig. 1) production was stepped up proportionately.

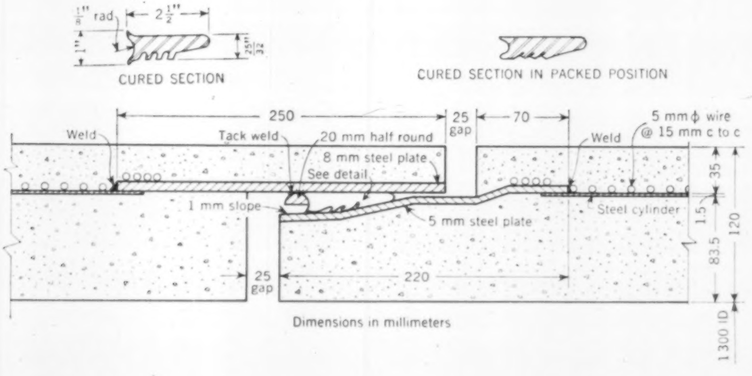
On removal from a previous casting, the inside vacuum form is placed on a new base ring and a clean loose nylon cloth is slipped over it. The steel cylinder jacket which is lowered over the form is braced by a "corset" which stiffens the jacket on the outside and also carries the working platform.

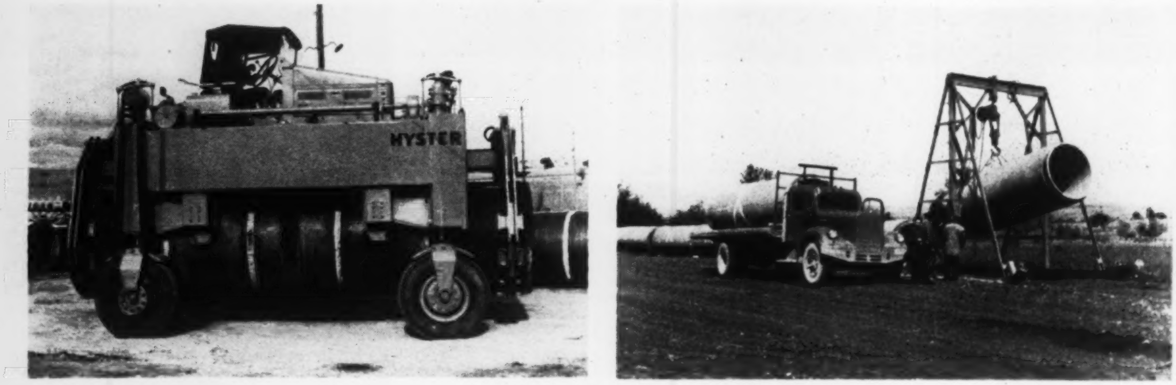
Concrete is transported from the central mixing plant in buckets by fork-lift trucks. The crane lifts the bucket and pours the concrete into the pipe core through a "Chinese hat." The inside form is fitted with 6 Bosh vibrators producing 12,000 vibrations per minute.

After the concrete has been placed, vacuum is applied through the inside form for approximately 40 minutes. At

← FIG. 2. New section of Athens Aqueduct extends from Mouriki (far left) through Viliza Pumping Main, a distance of 25 miles.

↓ FIG. 3. Rubber gaskets of special design join 20-ft sections of prestressed, precast pipe.





Transport of pipe lengths within casting yard was done entirely by one Hyster straddle truck (above), which proved entirely satisfactory. To place pipe lengths in trench, a special skid-mounted gantry was designed, seen above at right. This eliminated need for an additional expensive crane, which would be idle much of the time. When length in position has been lowered, truck will move forward, pull gantry into new position, and back under it for removal of pipe length.

the end of this period, the form is lifted out by the crane and lowered onto another base ring ready to cast the next pipe. The cloth sleeve left inside the pipe is peeled off of the newly placed concrete and washed with water while another cloth sleeve is used for the next lining.

After removal of the inside form, the pipe is covered with a wooden cover and remains on its base ring for two days. It is then tilted to a horizontal position by the crane, and taken away by the Hyster straddle truck for curing. Pipes are left for curing (without the use of steam) for at least two weeks before prestressing. One straddle truck proved sufficient for all moving of pipe lengths within the casting yard and it is giving excellent performance.

Concrete plant and mix

The concrete mixing plant consists of two Universal 9-cu ft mixers of horizontal type, made by Pedershaab Maskienenfabrik of Denmark. Concrete is tested daily in a field laboratory.

Concrete consists of sand and gravel with Type I Portland cement, manufactured by the Titan Cement Co. of Greece. The gradation of the aggregates follows the curve of Faury, and the quantity of cement used amounts to 400 kg per m^3 (about 670 lb per cu yd). To get the workability of a 6-in. slump, Lissapol, a wetting agent, is used in the mix. The water-cement ratio of the fresh concrete varies from 0.42 to 0.44.

The water extracted from the core concrete in the vacuum process is collected in a water tank and measured. The amount has averaged 60 kg per cu m (about 12 gal per cu yd), resulting in a reduction of the water cement ratio from 0.42 to between 0.31 and 0.33.

To check the compressive strength of the concrete, vacuum processed cylinders 6 in. × 12 in. are cured under the same conditions as the pipe core and coating and tested in the laboratory at the site. The values plotted in Fig. 4 give the compressive strengths obtained from these cylinders, taken from both the core and the outside coating of the pipe lengths.

Since the cylinders are not vibrated and are not of the same shape and thickness as the concrete in the pipe, they are not exactly representative of the strengths obtained in the pipe. From several comparative tests between test cylinders and specimens taken from actual pipe, it has been established that the strength of the concrete in the pipe is higher by 20 to 25 percent.

The specified minimum compressive strength was 4,500 psi (a cube strength of approximately 400 kg per cm^2). This has been considerably exceeded by the test cylinders, which have shown an average cube strength of over 500 kg per cm^2, or a cylinder strength of 6,000 psi.

The average specific gravity of the core concrete was 2,400 kg per m^3 (150 lb per cu ft) with gravel having a specific gravity of 2.50 and sand with a specific gravity of 2.65.

Several absorption tests gave values varying from 1.45 to 2.35 percent. These low absorption values (as against 8 percent permitted by ASTM Specification C 13 for concrete pipe) are typical of the dense concrete obtained by vacuum processing.

Circumferential prestressing is done on a BBRV machine, which wraps the wire around the pipe while the latter rotates, standing vertically. The machine has a capacity of more than 24 pipes per day, including all time lost for mounting and off-loading the pipe from the machine.

The 5-mm cold-drawn steel wire has a minimum ultimate strength of 16,000 kg per cm^2 (226,000 psi). It is wound under tension that is maintained constant by an automatic device in the prestressing machine. Stress in the wire is shown by a dial on the machine and can be checked accurately with a Vogt dynamometer. The wire is spliced by a Vogt machine that winds piano wire under tension over the overlapping ends.

The set-up for placing the concrete covering on the outside of the pipe is similar to that used for placing the core, and the pipe is held in a vertical position as before. An outside vacuum form is used and removed after 30 minutes of vacuum processing. The circular crane used has a 10-ton electric hoist. With a total of 24 base rings, the 12 pipes covered with concrete daily can remain for 48 hours before being removed for storage.

It is not an easy matter to place concrete vertically in a layer 1⅜ in. thick and 20 ft deep, against one face lined with cloth and the other covered with horizontal prestressing wires, without segregation. To find means of solving this problem, a series of full-scale pilot tests were carried out at the laboratory of Vacuum Concrete Incorporated in Philadelphia by the writer. After various mixes were tried, it was decided to use a very wet mix (11-in. slump) containing Intrusion Aid of a special type, made for this purpose by the European subsidiary of the Concrete Chemicals Co. of Cleveland, Ohio. The addition of Intrusion Aid, which contains suspending agents, eliminated completely any segregation either vertically or transversely, while the concrete

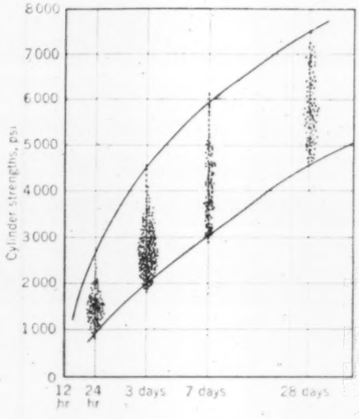
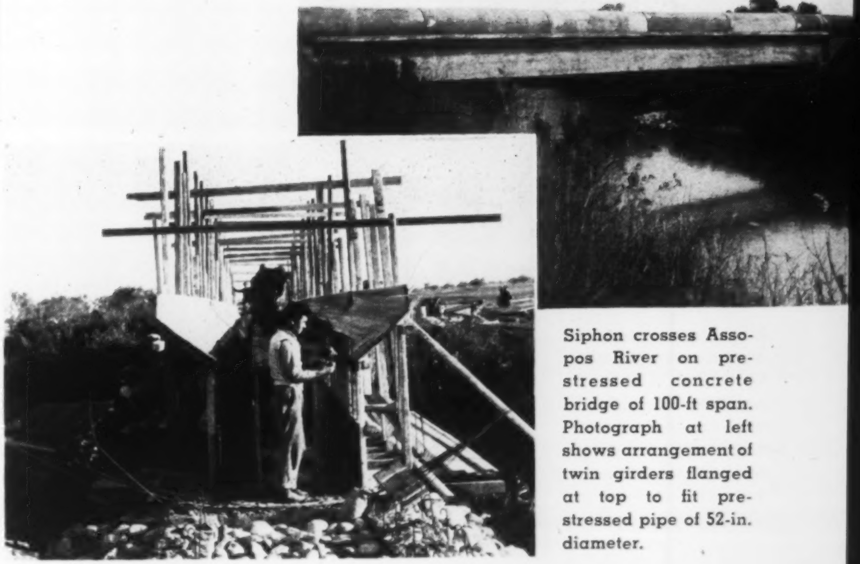


FIG. 4. Cylinders made of concrete from both pipe "cores" and coatings showed strengths much greater than specified.



Siphon crosses Assopos River on prestressed concrete bridge of 100-ft span. Photograph at left shows arrangement of twin girders flanged at top to fit prestressed pipe of 52-in. diameter.

strength remained well over the specified minimum of 4,500 psi.

The mix for the outside pipe coating contains gravel with a maximum size of 10 mm (3/8 in.), and 475 kg of Type I Portland Cement per cu m (about 800 lb per cu yd).

Quantities per cubic meter are: cement, 475 kg; sand, 630 kg; pea gravel, 910 kg; Intrustion Aid, 5 kg; and water, 246 kg. This gave a water cement ratio before vacuum processing of 0.52 with an 11-in. slump.

The water extracted from the pipe covering through vacuum processing amounted to 90 to 100 kg per cu m (18 to 20 gal per cu yd), thus reducing the water cement ratio from 0.52 to between 0.31 and 0.33.

Compressive strengths obtained from this mix are plotted in Fig. 4. Again, the average 28-day strength, specified at a minimum of 4,500 psi, exceeded 6,000 psi.

The average specific gravity of this concrete was 2,400 kg per m^3 (150 lb per cu ft), the sand and gravel having specific gravities of 2.65 and 2.50 respectively. The absorption of this cover concrete again was low, varying from 1.50 to 2.30 percent.

Completed pipe lengths are tested four at a time in an 85-ft-long pit with concrete bulkheads capable of withstanding a horizontal pressure of 300 tons. The four pipes are laid endwise and joined together with the same rubber gaskets to be used in the final installation, thus making it possible to pressure test the pipe as well as the joints. The first pipe length is fitted on a bell cast on one of the two concrete bulkheads of the pit and the fourth pipe is closed with a steel cover fitted with a pipe spigot and jacked against the second bulkhead of the pit.

The specification calls for testing the pipe lengths for the siphon at a pressure equal to 140 percent of the static head and the pipes of the pumping mains at twice their design pressure.

During a test of four pipes at a pressure of 300 ft and more, to test the effectiveness of the joint, one of the intermediate joints between two of the pipes was shifted 6 in. with a jack, while the pressure was maintained. There was not the slightest sign of leakage, thus proving the self-regulating capacity of the wedge-shaped Flexlock rubber gaskets (Fig. 3).

The Department of Public Works is following a conservative approach for this prestressed pipeline, the first to be built in Greece. The amount of prestressing has been increased to give zero stresses in the concrete for the siphon at the hydrostatic pressure increased by 10 percent, and for the two pumping mains, because of water hammer, at the hydrostatic head increased by approximately 80 percent.

Pipe lengths are transported from the casting yard to the site by regular trucks and off-loaded near the trench by a specially built skid-mounted gantry shown in a photograph. Laying is done by two separate, independent crews, each equipped with one 5-ton crane, which lowers the pipe length into the shallow trench and holds it until the new pipe length has been jacked into position. With two crews, laying is proceeding at the rate of 30 to 40 pipe lengths per day.

The laying operation is closely followed by a crew which tests each individual joint to a pressure equal to approximately 100 psi. The testing is done by a specially built joint-testing device, which can be fixed inside the pipe as an internal ring around the joint. Pressure is applied to the joint by introducing water which fills the space between the test ring and the joint. This precautionary measure eliminates any danger of defective joints between pipes. Finally the pipe is covered with a 3-ft protective layer of earth.

As of August 1, the 22,000-ft Assopos Siphon and the 4,200-ft Villiza Pumping Main were completed. Before backfilling, they were tested at 140 percent and 200 percent respectively of their working pressure and did not show a drop of leakage at any joints.

Near its lowest point, the siphon crosses the Assopos River on a bridge of 100-ft span. This bridge was made of prestressed concrete girders post-tensioned with BBRV cables.

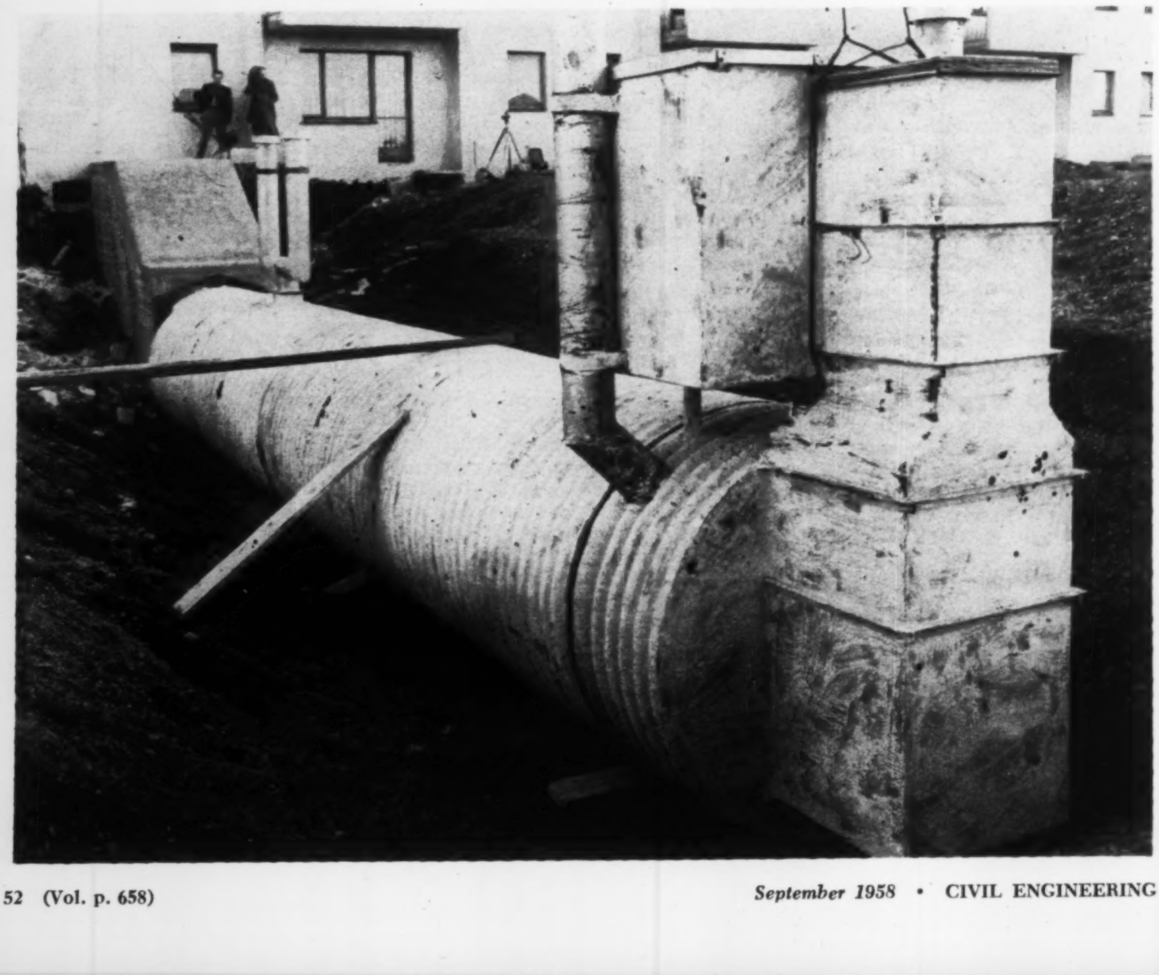
The project is being constructed by Domiki Inc. of Athens, Greece, with P. Kapassakalis, General Manager, and N. Sophos, Project Engineer. Domiki Inc. is acting as subcontractor to the joint venture, Etka-Technika Erga, the general contractor. The project is under the supervision of the Direction of Hydraulic Works of the Department of Public Works, of which S. Xanthopoulos is Director, and E. Angellidis, Project Superintendent. The pipe was designed by M. R. Ros of Zurich, Switzerland, and the writer, who has also acted as specialized consultant to the contractor.

The Vacuum Concrete process was used for casting of concrete, and the prestressing was done with a BBRV prestressing machine of Bureau BBR, Zurich. The rubber joints for the pipe were supplied by the Flexlock Corporation of Kent, Ohio, and Intrusion Aid for the concrete by the Concrete Chemicals Co. of Cleveland, Ohio.

German Type A shelter, shown in this group of photos, is identical in all respects with that tested in Nevada, and shown in Fig. 1, except for furnishings. On entering heavy steel blast door, at left in (1), observer faces gas door at other side of air lock. Outlining of this door and other areas with luminous paint or tape (2) was found to eliminate panic among occupants in event of power failure. Small round "window" to right of gas door is sealed from inside with hand-operated device until its opening is considered safe. Pump (3), which forces fresh air in through sand filter, can be electrically or manually operated. Drum-like object is auxiliary filter, included in series with sand filter. Shelter has seating and sleeping facilities (4), plus emergency blast-proof exit (5) for use if main door is ruptured.

Low-cost blast-protective construction

CHARLES CURIONE, Lt. Comdr., CEC, USN, Bureau of Yards and Docks, Department of the Navy, Washington, D. C.



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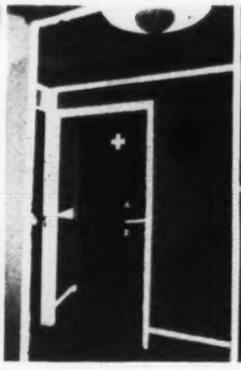
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Protective construction against blast as practiced by the U. S. Navy has features that can be adapted to all civilian construction at little increase in cost for a great increase in resistance. In Navy jargon this is known as "slanting," which is defined as "the incorporation, without an appreciable extra cost or reduction in efficiency, of certain architectural and engineering features into new permanent-type structures or portions thereof, to improve their resistance to damage or to protect materials, functions and/or personnel from the various effects of attacks." These features may provide immediate improvement in this respect, or may facilitate later conversion for this purpose. The principles involved can be applied at each step in the building process, that is, in planning, design, and construction.

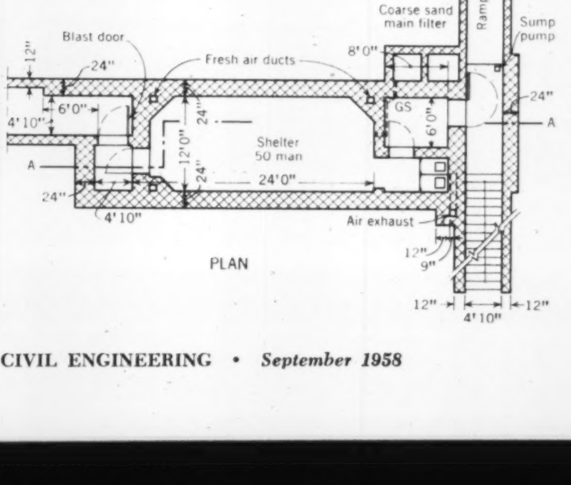
It has become the Navy Department's policy to plan for an appropriate degree of protection for all facilities. This is being done by a careful application of slanting principles, although it is realized that a slanted structure cannot be designed to provide protection from any specific level of weapon effects. By using the principles of protective design, the degree of protection afforded by a structure is increased but not necessarily to a predetermined quantitative level. It is therefore considered one of the most important means of improving the resistance of structures of the shore establishment against the hazards of atomic, biological, and chemical warfare. It is believed that continued application of the principles of slanting over a period of time will reduce the overall effects of an enemy attack and will result in a dollar saving for the government. The full potential of slanting is dependent on the ingenuity of the planner and designer and the scrupulous application of these principles by all personnel concerned.

Navy "slanted" design

The Bureau of Yards and Docks of the U. S. Navy recently issued an instruction titled, "Design Criteria for Slanting New Permanent-Type Construction." It provides a suggested list of slanting measures that can be included in structures within the scope of "little or no extra cost." Many of these measures are applicable to civilian construction. The following are important:

Prefabricated cylindrical shelter, about 7½ ft in diameter, is seen in place before backfilling. Sand filter and emergency exit door are at near end. This Class B shelter, in Duisberg, Germany, of corrugated metal with 1½-in. outer concrete coating, resists 45 psi. It can be erected in four days including complete site preparation.

FIG. 1. Type A shelter of this design suffered no major damage when exposed to effects of 43 kiloton nuclear device, exploded from top of 700-ft steel tower at Nevada Test Site.



1. When the supporting members of the roof framing are beams or girders, the bottom reinforcing of the concrete should extend into the supports and be anchored or spliced for full continuity.

2. Exterior walls should consist of moment- and shear-resistant framing or panels, and unreinforced brick or block construction should not be used for such walls. For interior shear walls, preference should be given to relatively rigid-type framing over masonry. Adequate anchorage or connections should be provided between the structural partitions and the framing.

3. Windows weaken the strength of wall framing, and window glass constitutes a serious hazard under blast forces. For these reasons, openings should be eliminated or minimized.

4. Exterior doors should preferably be located in the longitudinal walls. When it is necessary to provide doors and windows in end or transverse walls, they should be located in the middle third of the span or width of the wall.

5. All exterior walls and interior shear walls should be securely connected to the foundations to resist uplift and overturning. Where the walls are supported on grade beams or spandrels, the latter members should be designed for bending and twist.

6. Floor slabs should be integrated with beams or stringers. Where use is made of concrete slabs and steel beams or stringers, the slabs should have sufficient reinforcing in their bottom faces to develop a positive moment strength over the supports equal to one-half that of the design negative moment. In addition, the slab should be securely anchored to the support in order to prevent shear slippage or pull-out.

7. In precast concrete construction, floor slabs should preferably be cast with the stringers to form integral panels. Connections of such floor panels to each other and to the main frames should be made by means of metal inserts cast in the elements and welded together in the final assembly work.

8. Buildings should be oriented to minimize blast effects.

9. The area surrounding buildings should be graded and surfaced to facilitate fallout removal during the decontamination process.

10. New construction should be avoided in areas where there are flammable structures or buildings.

11. Advantage should be taken of topographical shielding where possible. (However, terrain must be quite rough to provide appreciable blast protection.)

12. Irregular exterior surfaces should be held to a minimum, also unnecessary ornamentation on the outside of structures.

13. At least one glass-free area should be provided in any building that may house personnel, where this is possible.

14. Provision of butts, anchor bolts, etc. should be considered to permit the installation of portable or fixed air locks, should this be considered necessary.

15. Special consideration should be given to the following:

a) Emergency exits from shelter area

b) Sealing of all exterior openings and cracks to prevent entrance of contaminants and low blast pressure

c) Secure anchorage for all equipment. (Shock mounting should be provided for equipment that may be destroyed by sudden movement or may act as a missile.)

d) Use of non-porous materials wherever possible on exterior surfaces of structures to facilitate decontamination and removal of radioactive particles.

e) Avoidance of brittle materials where feasible.

European shelters

In many cases such slanting will not be adequate or in time. Where it is desirable to provide better or separate protection, current European practice offers a guide. The Scandinavian countries are far in the lead in this field. There shelters have been provided for people, industries and storage by utilizing new or existing tunnels, shafts and mines located deep in soil and rock.

Germany is providing rectangular and circular reinforced concrete shelters in areas remote from hilly terrain. The German Civil Defense believes that only three specific types of shelter are practical and has established these as standard: Type A, resistant to 125 psi of peak overpressure; Type B, resistant to 45 psi; and Type C, resistant to 15 psi of such overpressure.

A Type A shelter (Fig. 1) was tested on 31 August 1957 at the Nevada Test Site. It received the effects of a 43 kiloton nuclear device exploded from the top of a 700-ft steel tower. The A-type shelter was subjected to pressures of 195 psi and suffered no visible damage except on the outside open entranceway. However, the entranceway was not damaged sufficiently to prevent access or egress to and through the main entrance to the shelter. The wall, ceiling, and floor thickness of the A-type shelter is 24 in. of heavily reinforced concrete. Shelters of Types B and C differ only in wall, ceiling and floor thicknesses, which are respectively 20 in. and 16 in.

The German Federal Republic has spent many millions of dollars for shelter construction alone, all financed by the federal government. In addition, private construction is almost forcibly encouraged to construct basement shelters in almost all new buildings to accommodate a number of people. Present plans call for spacing between shelters to be no greater than 390 ft. A shelter of Type A, B, or C is capable of housing 50 persons at a cost per person of $225, $150, and $107 respectively. These costs include everything except such items as bunks, chairs, and medical supplies.

One of the shelters inspected by the writer in Germany was in the subbasement of a large bank building in Düsseldorf. The walls, floor and ceiling each had an effective thickness of concrete of about 3.3 ft. Intermediate-grade steel was used as reinforcing and the percentage of steel exceeded 1 percent. This shelter included provisions for housing four 50-person groups, plus a first-aid room and a gas resistant chamber. It was equipped with gas and blast resistant doors and with ventilation facilities activated by natural, by electric-drive mechanical, and by hand-driven mechanical means.

The Federal Republic of Germany consists of 13 states somewhat separately controlled in a similar fashion to those of the U.S.A. The protective construction program is financially supported jointly by the federal government, the state and the city concerned, each paying one third of the sums expended. The State of Westphalia requires that all new public buildings include a basement shelter meeting the requirements and specifications of the Civil Defense Department of that state. To date, this state is the only one that has made a rigid rule governing such installations.

Action towards the provision of protective construction in the United States is for the most part just talk. In Europe, such structures are actually being built. It is human nature for Americans to resist the investment of time, money and effort in something designed to avoid or minimize a danger that may never materialize. This is particularly so because we have not heretofore been subjected to direct assault within our continental borders. However, atom and hydrogen bombs are now in our arsenals and in the arsenals of our potential enemies, and time for such a huge protective construction program for both the military shore establishments and the civilian population is indeed not on our side.

It is sad to note that almost twelve years after Hiroshima, the United States finds itself so vulnerable to the very weapon which its superior technology created. The United States should make a genuine effort to include protective design in all future construction so as to provide this protection at the lowest possible cost and in the shortest possible time.

Radiation barriers in a reactor plant

B. JOHN GARRICK, **Chief Nuclear Scientist, Holmes & Narver, Inc., Los Angeles, Calif.**

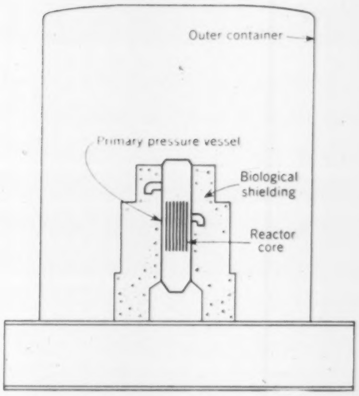

Outer container
Primary pressure vessel
Biological shielding
Reactor core

FIG. 1. In simplified diagram of typical reactor plant, parts of particular interest to civil engineers are primary pressure vessel, reactor shield, and outer container.

Of the unique problems associated with reactors, among the most difficult to solve are those concerned with the behavior of materials and the confinement of radiation. Not only do the materials selected have to meet rigid specifications for mechanical and chemical properties, corrosion resistance, wearing ability, and fabrication requirements, but they must also be able to withstand the effects of such phenomena as radiation, internal heat generation, and induced radioactivity.

Radiation is normally confined by a series of barriers between the reactor core and public access areas. The design of these barriers, generally done by a civil engineer, involves finding compatibility between structural requirements, available materials, shielding specifications, and safety considerations.

For this discussion it will be assumed that the reactor core is a black box from which the characteristic radiation is emitted. The comments are confined to the primary pressure vessel, the reactor shield, and the outer container of a reactor system. See Fig. 1.

Primary pressure vessel

Without regard to specific materials, there are four main phenomena that decrease the effectiveness of the material in a given reactor pressure vessel:

1. Conditions of stress
2. Low-temperature embrittlement
3. Hydrogen embrittlement
4. Irradiation-induced embrittlement

The first three of these are affected indirectly and may be accelerated by radiations from the reactor, but they are not new, having been encountered in conventional systems, and will not be considered here. Irradiation-induced embrittlement, which is unique to nuclear systems, is the subject of this article. See Fig. 2.

The radiations from a reactor consist of alpha and beta particles, gamma radiations, fission fragments, neutrons and in some cases protons. Because of low production rate or short range, the alpha and beta particles, fission fragments, and protons are normally of no concern. The effects of gamma-rays will be discussed later. Essentially all physical damage to the pressure vessel results from high-energy (fast) neutrons. This damage, called radiation damage, is caused by a collision between a neutron and an atom. More accurately, a neutron colliding with a nuclei in the pressure vessel may transfer sufficient energy to cause the nuclei to be displaced from its equilibrium position in the space lattice, thus leading to a physical change in the material.

Since the properties of solids are dependent on the positions of atoms in space, the atomic picture is very convenient for explaining the effects of radiation. See Fig. 3. Anything done to change the fundamental arrangement (crystal structure) of the atoms in a solid will also change the physical properties of the material. Several theories have been postulated to account for the action of radiation on materials. Among the principal ones are atomic displacement, impurity atoms, and thermal spikes.

Atomic displacement. When a neutron strikes a solid material an atom may be displaced from an equilibrium position in its crystal structure, leaving an unoccupied site known as a "vacancy." The displaced atom will come to rest either at another vacancy, which is an equilibrium position, or at some non-equilibrium position in the lattice where it becomes an extraneous atom known as an "interstitial" atom. The consequence of a vacancy and an interstitial is to strain the lattice, producing an effect similar to that resulting from cold-working of the material.

Impurity atoms are new atoms introduced by neutrons reacting with other materials. It is believed that the

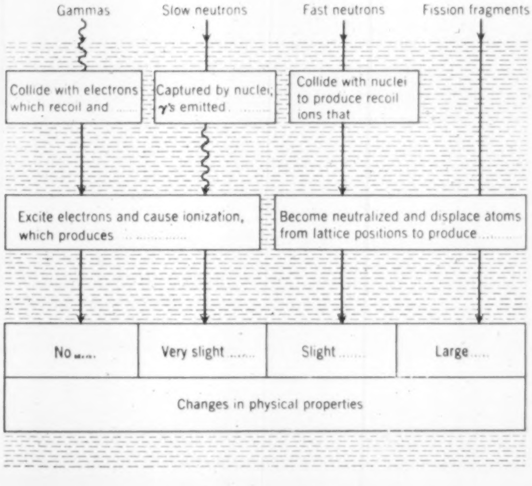

Gammas
Slow neutrons
Fast neutrons
Fission fragments
Collide with electrons which recoil and ....
Captured by nuclei; γ's emitted. ....
Collide with nuclei to produce recoil ions that
Excite electrons and cause ionization, which produces ....
Become neutralized and displace atoms from lattice positions to produce ....
No......
Very slight ......
Slight ......
Large.....
Changes in physical properties

FIG. 2. Factors causing radiation damage to metals are shown diagrammatically. From Nucleonics, September 1954.

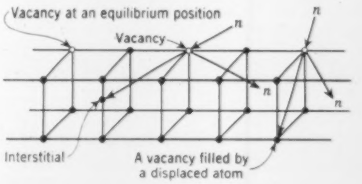

Vacancy at an equilibrium position
Vacancy
n
n
n
n
Interstitial
A vacancy filled by a displaced atom

FIG. 3. Damage to a material by radiation may be explained by production of vacancies and interstitials in the atomic lattice, or crystal structure of the material. ➤

damage caused by this mechanism is of second order compared to other effects.

A thermal spike is created when a neutron, in colliding with atoms, loses a large fraction of its energy within a very small volume and rapidly dissipates it in heat. This leads to a localized region of high temperature and is referred to as a "thermal spike." The result is the possible liberation of vacancies and interstitials and hence radiation damage.

Based on available data, some general observations can be made about the effect of irradiation on the properties of engineering materials. The atoms in materials being irradiated continually undergo a certain amount of migration from one lattice position to another, including movement to equilibrium sites. The latter phenomena indicate that some healing of radiation damage occurs simultaneously with damaging effects.

The rate of migration (or recombination) increases with temperature and hence the rate of healing (or annealing) also increases. An increase in temperature decreases the amount of radiation damage; in fact there is a temperature and a time at which a material exposed to a constant flux of neutrons will experience equality in the production of defects and the rate at which they are spontaneously healed by recombination.

Thus the effects of nuclear radiation on metals are greater at lower temperatures. Unless the temperature is high enough to cause adequate annealing, neutron irradiation increases the tensile and yield strength and hardness of metals. In some metals radiation damage also causes an increase in the transition temperature between ductile and brittle fracture. Probably the best analogy between radiation damage and conventional engineering operations is to compare radiation damage with solution hardening, where the presence of impurity atoms in a lattice has the same effect as exposure to radiation. The stress-strain curves of solution-hardened alloys are similar to the stress-strain curves of alloys hardened by lattice damage.

Although most of the available data indicate that the time-integrated neutron fluxes necessary to inflict serious damage are high enough to present no serious problem in existing reactors, the effects of long-time irradiation, such as will occur in many of the proposed power reactors, have not been definitely established. Some information has been made available as a result of the testing of materials in existing reactors, particularly the Atomic Energy Commission's Materials Testing Reactor, which is being used as a design basis for some of the new reactors.

Aside from the fact that radiation damages the crystal structure of materials in a primary vessel, there is another problem, probably of even more significance to the engineer, caused by the heating and thermal-stress conditions brought about by gamma and neutron radiation.

About 5 percent of the total heat produced in a reactor results from the absorption of gamma radiation leaving the core. This occurs not only in the primary vessel but in the other external components as well, including the biological shield. The two main sources of heat generation in vessels and shields are gamma rays and neutrons. Predicting the heat generation and hence the temperature distribution due to these radiations involves a determination of their sources, absorptions, and collisions for various energies.

The neutron flux at the surface of a vessel may be as high as 10^{15} neutrons per sec per cm^2. Gamma fluxes resulting from neutron reactions will be of the same magnitude. These intensities could lead to an energy flux greater than 10^{15} mev per sec per cm^2 or 500,000 Btu per hr per ft^2. (1 mev=1 million electron volts.) Internal heat generation in steel can be as high as 10 watts per cu cm. Since pressure vessels for large power reactors are heavy walled, it becomes necessary to reduce the radiation before its entry into the vessel or the thermal stress problem could become prohibitive. Reduction in radiation intensity is accomplished by a series of shields known as thermal shields, cooled on both sides, between the reactor core and the vessel wall. Obviously it is mandatory to consider gamma and neutron heating in designing pressure vessels for reactors, so that the expected thermal stresses can be adequately analyzed.

Reactor shield

The next barrier against radiation from a reactor to be discussed is the biological shield. Actually, shielding commences inside the core itself with the fuel elements, coolant and moderator, thermal shields and primary vessel. The reference to shield involves that part of the system exterior to the primary vessel, and this discussion is confined to shielding against radiations from the core only, and not from the circulating loop.

Radiations normally emanating from the primary vessel, which require attenuation in the biological shield, are neutrons and gamma rays. Whereas neutrons have as their origin the fission process within the reactor fuel, gamma-rays originate from processes not only in the fuel region, or core, but exterior to the core as well. The neutrons are responsible for the sources of gamma-rays outside the core since neutron absorption in some materials leads to the production of gamma-rays of very high energy. It is these gamma-rays that complicate the shielding problem and usually dictate the total thickness of the shield.

Unfortunately, gamma-rays and neutrons are not most efficiently attenuated by the same materials. As a matter of fact, the most effective neutron shield material is one of low mass number, such as water, carbon or paraffin, whereas the most effective gamma shield is a material of highly density such as iron, lead or uranium. This arises from differences in their methods of attenuation.

From the above it would appear that the best shield would consist, first of a material of low atomic number to slow down and absorb the neutrons, followed by a material of high density to absorb gammas. However, there exists a collision mechanism (inelastic scattering) between high-energy neutrons and high-density materials that effectively reduces the neutrons' energy to a level at which they can be most effectively absorbed by materials of lower atomic number. Therefore the optimum shield would be one in which a material of high mass number is mixed uniformly with a material of low mass number in proportions that would satisfactorily reduce the gamma and the neutron flux to an acceptable safe level at the same time.

This arrangement is not often practicable because the low-mass material is usually in the form of a liquid such as water (or hydrogen compound) and the heavy material is normally a solid such as iron or lead. Although a laminated shield, that is, one consisting of alternate layers of low- and high-mass materials, is an attractive solution, this approach has been found to be very expensive. It has fortunately been found that equally effective neutron and gamma attenuation can be achieved at considerably lower cost by incorporating the heavy element, such as iron or barium, in concrete, which normally consists almost entirely of elements of low mass number, including hydrogen. Concrete also can serve as a structural material.

It should be noted that the laminated shield philosophy is incorporated, in part, inside most reactor primary pressure vessels as a result of the thermal shields. Although these shields have as their main function the reduction of the gamma heating in the primary vessel and biological shield, their arrangement, which is normally that of thick concentric shells of steel around the core separated by a coolant, provides an effective attenuation medium for both neutrons and gamma-rays.

It should be noted that if access to the reactor vessel or to internal regions of the reactor becomes necessary during operation, special precautions must be taken to avoid unnecessary leakage of radiation. Any access facilities should be in the form of a shielding plug or a staggered or labyrinth door arrangement to avoid streaming of radiation.

In summary, the biological shield in a reactor usually is made up of materials of low and high mass number. These may be water, beryllium, iron or steel, lead, concrete, and ore aggregates of concrete. Biological shields are vulnerable to radiation damage and thermal stress problems just as structural members closer to and inside the core, but on a much lower scale.

Outer container

The final barrier against radiation is the outer containment vessel. This vessel is theoretically independent of the reactor system and not an integral part of it as are the primary pressure vessel and the biological shield.

Its function is to provide protection against the release of gaseous and particulate radioactive material from the reactor core in case of an accident resulting in failure of the other barriers. Thus the containment vessel or shell represents a part of the reactor system that has a purpose only in the event of a disaster which every known precaution has been taken to prevent. Because of the added expense involved and the extremely low probability of disaster, the need for building a containment structure is sometimes questioned.

Too often reactor systems are believed to represent a public hazard from the standpoint of the possible release of blast and heat as do nuclear weapons. Many are surprised to learn that even in the worst reactor incidents the direct-blast damage would not normally extend beyond the facility building. Unfortunately reactors of high operating power produce within the fuel material very large quantities of radioactive fission products and materials. The maximum tolerable atmospheric concentrations of radioactive materials may be thousands or even millions of times lower than those of chlorine, phosgene, or other gases normally considered highly poisonous. Consequently if these radioactive substances were to be released to the atmosphere in a populated area the result could be widespread death or permanent injury to the inhabitants and serious economic loss. Furthermore, the art of reactor technology has not advanced to a state where the accident potential of a reactor can be predicted with complete confidence. These two factors, namely the potential hazards associated with the large fission-product inventory characteristic of power reactors and the inability to assess with complete confidence the magnitude and probability of accidents appear to justify the added expense and effort required to provide containment.

Of course the containment structure is an appropriate safeguard only if there is assurance that it can withstand accidents causing failure of the primary containers. Such accidents may be characterized as nuclear, mechanical, chemical and combustion. Although it is likely that an accident would have its origin in only one of these, it could involve all four.

The type of accident to which reactors are most vulnerable seems to be that due to mechanical failure. For example, the stored energy in some pressurized water reactors, as in any high-pressure system, may be equivalent to tons of TNT. Should mechanical failure occur in the primary loop, all or part of the energy might be released to do destructive work. Expansion of the high-pressure water could conceivably starve the reactor of its coolant, thus causing it to melt and release fission products. Obviously adequate containment must be provided to withstand this type of accident.

An exothermic chemical reaction could conceivably evolve from the mechanical accident just described. It has been shown both theoretically and experimentally that under proper conditions some characteristic reactor materials, such as aluminum and zirconium, are capable of reacting exothermically with a commonly used coolant, water. The conditions necessary for these reactions involve, as a minimum, temperatures exceeding the metal's melting point. For nuclear plants in which these reactions are possible, consideration has to be given to avoiding the spread of radioactivity by this mechanism.

Finally, some reactors incorporate a combustible coolant, such as hydrocarbons, sodium, or sodium compounds. An accident involving the release of these materials might result in a serious fire. Provisions to cope with this situation must be considered in the containment analysis.

It is of interest to note that even if a serious reactor accident occurred in which more than one of the above mechanisms were involved, the pressures would not necessarily be compounded since the reaction times of the various mechanisms are not the same. For example, a hydrogen fire could follow a metal-water reaction from which the hydrogen was produced.

Thus far the discussion has been in terms of containment capable of withstanding sudden rises in pressure following certain types of accidents. It is of equal importance that containment be gas-tight to a high degree. It is entirely conceivable that a leakage rate as low as 1 percent of the containment volume per day could not be tolerated in a vessel of 500,000-cu ft capacity containing an accident from a large power reactor. In some cases leakage rates would have to be smaller than this by a factor of ten or a hundred—or even a thousand. Obviously such infinitesimal leakage rates are extremely difficult to ensure. Although methods of measuring such leakage rates have not been completely adequate in the past, very effective techniques are now being developed and used.

In addition to being capable of withstanding a sudden increase in pressure and remaining gas-tight, a containment vessel must be able to withstand missiles originating from accidents associated either with the reactor or with its auxiliary components. Missile protection (in the form of concrete or steel plate) may be confined to areas exposed to the most likely source of missiles or may be applied on the inner surface of the containment vessel in the form of concrete or other material capable of withstanding shock loads. The philosophy used in designing missile protection depends on many factors among which are space requirements, size of components, number of potential missiles, and physical arrangement of the equipment.

The problems confronting the engineer called upon to design major structural members for nuclear plants are numerous and varied. An exchange of ideas in this new field of structures is essential.

(This article was originally presented by Mr. Garrick as a paper at the ASCE Chicago Convention, before a Structural Division session presided over by David Lee Narver, Jr., Chairman of the Division's Committee on Nuclear Structures and Materials.)

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CONGRESSIONAL REGULATION

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Any suggestion that the engineering profession, its employees, their wages and hours, fees, profits, and the like, can be regulated by Congress to the same extent that meat packing, coal mining, railroads, and television are now regulated, may appear absurd. However, this is precisely the future our profession can anticipate if the decisions of several U. S. Circuit Courts are upheld; for these Courts have attached to the civil engineering profession the same touchstone nomenclature which has brought many another activity within the scope of Congressional regulation by finding them all engaged in "interstate commerce."

The far reaching impact becomes apparent when we recall that the commerce clause of the U. S. Constitution grants Congress the power to make all laws necessary and proper for the regulation of interstate commerce—and the power to regulate is the power to prohibit, restrict, protect, restrain, promote, or in all ways to govern through legislation.

Courts divided at present

Fortunately, these decisions have not been uniformly adopted by all Federal Courts. Notable amongst the dissenters is the 4th Circuit, comprising the States of North and South Carolina, Virginia, West Virginia, and Maryland. It may be expected that ultimately the U. S. Supreme Court will be called upon to resolve this conflict between the Circuit Courts. At that time, should the Supreme Court hold that the practice of civil engineering is within the scope of Congressional regulation, then the only remaining legal restriction on the exercise of such regulatory power will be those limitations contained within the Constitution itself.

The interstate commerce aspect of civil engineering arose during litigation under the Fair Labor Standards Act. This Act provides that "Every employer shall pay to each of his employees who is engaged in commerce or in the production of goods for commerce" not less than a statutory wage, nor shall an employee receive less than one and a half times his basic salary for all work over forty hours per week.

Exempt from the Act are all bona fide professional, executive, and administrative employees, along with learners, apprentices, messengers, and handicapped workers. Because any exemption from the power granted to Congress by the commerce clause is mere legislative grace, numerous restrictive provisos have been attached to each. For instance, whether an engineer is a professional employee is not determined solely on the basis of State registration or advanced education, but rather whether he earns over a statutory weekly wage and his primary duty involves the use of an advanced type of knowledge in a field of science or learning which he consistently applies in the exercise of discretion and judgment.

Commerce very broadly defined

And finally, the Act defines "commerce" as "trade, commerce, transportation, transmission, or communication among the several States or between any State and any place outside thereof." This reiterates the Constitutional provision that Congress shall "regulate commerce with foreign nations, and among the several States"—but it is the crux of the judicial antitheses; for what, in this modern day, isn't related in some way to the production of goods for, or used in, interstate commerce?

When the judiciary approached this question with relation to the practice of civil engineering, one group followed previous cases involving construction engineering employees, who had been uniformly held to be engaged in the production of goods for interstate commerce when the construction involved the extension, alteration, repair, or maintenance of an instrumentality used in interstate commerce. For example, contractor engineering employees engaged in work designed to relieve congestion, the construction of feeder and bypass streets, new bridges, waterways, docks and dams used to carry or serve interstate commerce, telephone, telegraph or other communication facilities, railroad and pipelines used for interstate movement of commodities, have all been held covered by the Fair Labor Standards Act. Therefore, when these courts were called upon to decide a question involving the consulting engineering personnel who had gathered the field data, designed and drafted the plans by which such construction was carried out, these courts refused to recognize any difference in degree or effect upon commerce between engineering and construction, or if there was any difference it was "of minor significance."[1]

Opposing this view are cases, typical of which is Mitchell v. Lublin, McGaughy & Assoc.,[2] which hold that the occupation of the engineer's employer must be considered because the consulting engineer's products are not "goods" for use in interstate commerce "but only a physical embodiment in words of professional conclusions." This court went further to add, "'Goods' should not be construed to include the typewritten or mechanical expression by which advice is given." As to any argument that consulting engineers are

OF ENGINEERING

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nevertheless engaged in interstate commerce because their work requires transportation and communication outside the State of their office, the court answered:

> "Communication which is merely incidental to the local enterprise cannot be classed as commerce. The interoffice communications in this case related to the local production of plans and specifications, and the field men who traveled from State to State were sent out to get the information as to the character of the work to be done, so that the architects and engineers might do their preparation work. All of these activities related to the production of plans, partook of their intrastate character, and cannot be fairly characterized as commerce between the States."

However, even those courts holding that consulting engineering is not interstate commerce, admit of instances where some field employees may nevertheless be within the Fair Labor Standards Act. Although the case quoted from above left this question unanswered, other courts have not been so reticent:

> "The inference is fairly deductible that the work of the 'resident engineer' was a vital factor affecting the progress of the construction project. Further, although the 'resident engineer' has no right or duty to direct or control the contractor in his work, the fact remains that completion of the project depends in no small way upon the services rendered by (the consulting engineer's) employees." [3]

Perhaps what the courts are here trying to avoid is any apparent discrimination between construction employees who must be paid time and a half while the consulting engineer's employees, working beside the contractor's men in the field, need not be.

It remains to be asked what limits there would be to any future Congressional regulation of the profession should the Supreme Court adopt a view placing civil engineering under the commerce clause. Could not Congress then, "in its wisdom," establish a mandatory national system of professional registration and prohibit all non-federally registered engineers from interstate activity? Or, if Congress can establish minimum wages for non-professional employees, could it not also establish higher minimums for professional employees under a theory that in so doing they were promoting a larger technical pool? Or, could it not grant an administrator the authority to establish regional fee schedules as a means of promoting or encouraging interstate construction and planning?

What limits on such regulation?

The only constitutional limitation lies in the "due process" clause of the Fifth Amendment. Of this limitation, a leading authority has stated: "In brief, this clause today goes to the substantive content of legislation, or in other words, requires that Congress exercise its powers 'reasonably,' that is to say, *reasonably in the judgment of the Court.*" [4]

Just how "reasonable" the Supreme Court has found the application of this Congressional power under the Fair Labor Standards Act is illustrated by its decisions that the following persons were engaged in interstate commerce: caretakers of a 22-story building in New York, heat being essential to warm the fingers of the seamstresses employed by a clothing manufacturer who rented space in the building and who sold goods across state lines [5]; employees of a window-cleaning company, the greater part of whose work was done on the windows of industrial plants of producers of goods for interstate commerce [6]; and so on until Chief Justice Stone protested that Congress did not "by a 'house-that-Jack-built' chain of causation, bring within the sweep of the statute the ultimate *causa causarum* which result in the production of goods for commerce." [7] On the other hand, the reasonableness of such holdings was supported by Justice Frankfurter, who replied that Congress, in enacting the Fair Labor Standards Act, "did not see fit . . . to exhaust its constitutional power over commerce." [8]

But those unwilling to chance the "reasonableness" of the political philosophy of a majority of the Supreme Court and who may yet possess a feeling of ambivalence towards possible future Congressional regulation of the profession, may well consider the advice of Chief Justice John Marshall who, with reference to the commerce clause, wrote in 1824:

> "The wisdom and discretion of Congress, their identity with the people, and the influence which their constituents possess at elections, are, in this . . . the sole restraints on which they (the framers of the Constitution) have relied to secure them from its abuse. They are the restraints on which the people must often rely solely, in all representative governments." [9]

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[1] Mitchell v. Brown, 224 F. 2d 359 (1955), cert. denied, 350 U. S. 875.

[2] 250 F. 2d 253 (1957), cert. granted (3-31-58, Docket No. 802), 356 U. S. 917.

[3] Supra, note 1.

[4] Edward S. Corwin, *The Constitution and What It Means Today*, Princeton University Press, 1954, page 217.

[5] Kirschbaum v. Walling, 316 U. S. 517 (1942).

[6] Martino v. Mich. Window Cleaning Co., 327 U. S. 173 (1946).

[7] Borden Co. v. Borella, 325 U. S. 679 (1945).

[8] 10 East 40th St. v. Callus, 325 U. S. 578 (1945).

[9] Gibbons v. Ogden, 9 Wheat. 1, 86, 87 (1824).

Cable-suspended roof for Yale Hockey Rink

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Well ahead of the 1958 hockey season, the new million dollar David S. Ingalls Rink at Yale University, designed by Eero Saarinen, will be completed. Under a wood-plank roof suspended on cables (some of them pretensioned), the column-free area is 228 ft long and 183 ft wide at the center. In addition to the rink, 198 x 85 ft, this area includes the 3,000 seats and the entrance ramps. See Fig. 1.

The main structural elements, completed some time ago, depend mainly for their effect on an interplay between reinforced concrete and steel cables. The final form was a result of intensive studies to determine the ideal envelope for an exciting game. In addition to the necessary facilities for players and spectators, the architect desired a dynamic, "non-static" design that would be stimulating to both. The result is a form that is both fuctional and pleasing.

In designing this unique structure, the geometrical computations required for preparing plans and stress calculations involved considerable effort, because the only parts of the structure that could be located in either vertical or horizontal planes were the rink itself and the seats and entrance ramps.

The steel cables that support the roof are suspended between the center arch and the curved exterior walls. The roof cables, $^{15}/_{16}$ in. in diameter, are spaced 6 ft on centers horizontally. Nine longitudinal cables are installed on each half of the roof. See Fig. 2. Two of these cables span between opposite points on the arch, four between opposite points on the exterior wall, and three between the two curved steel trusses, as shown in the figure. These nine cables, which were pretensioned after the wood plank roof was put on, ride in pipe sleeves over the regular roof cables.

The length of the center arch (Fig. 3) including the cantilevers over the entrances, is 333 ft. This arch rises to 75 ft above the rink at the center, and its cross section at the center is 3 ft wide and 5 ft high. Both dimensions increase towards the buttresses. The arch is braced laterally by three cables on each side. These cables, of 1¾-in. diameter, are anchored to the exterior walls.

All cables are galvanized bridge strands, fitted with bridge sockets for adjustment and pretensioning. Pretensioning was controlled by the use of a 100-in. Invar-nickel rule. Buttons were attached to the cables and marked in the shop for the required degree of cable tension.

The exterior walls, following opposite curves along the sides of the rink, are 183 ft apart at the center and 78 ft apart at the end glass enclosures. The highest point of the wall is 29 ft above the rink at the center and about 7 ft lower at the end enclosures. The walls are topped with a flat concrete section 1 ft 6 in. x 7 ft, to which the roof cables are anchored.

Within the center 240 ft of the structure, the arch and the various parts of the exterior walls generally follow parabolic curves. In the end portions these elements are shaped by a combination of a series of circular curves.

The roof deck is constructed of random lengths of 8 x 2 tongue-and-groove treated wood planks, nailed to two 2 x 6 nailers which, in turn are bolted to the cables. See Fig. 4. Since the volume of wood varies with its water content, the stiffening effect of the wood roof deck on the structure is uncertain and cannot readily be calculated, as would be the case for a continuous monolithic membrane. It is certain, however, that the roof deck has a great capacity to redistribute concentrated loads locally and to help reduce vibration in this featherweight roof construction. All roof loads are, of course, carried by the transverse cables. The sags of these cables were selected to be proportional to the squares of their spans. Thus, for a uniform load, the horizontal pull in all cables would be equal. The structure was designed for a roof live load of 30 psf.

The longitudinal cables serve various purposes. Their immediate effect on the structure is to act as roof tiedowns. The pretensioning, about 60 percent of the calculated maximum stresses, not only increases the effectiveness of the cables as tiedowns, but also preloads the roof construction. The preloading, which is equivalent to 10 psf, definitely prevents objectionable noisy vibration of the roof membrane. Pretensioning of the longitudinal cables is also of great importance to the stability of the structure, as will be shown later.

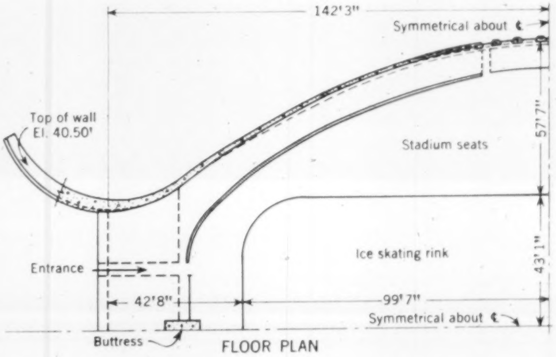
Exterior walls

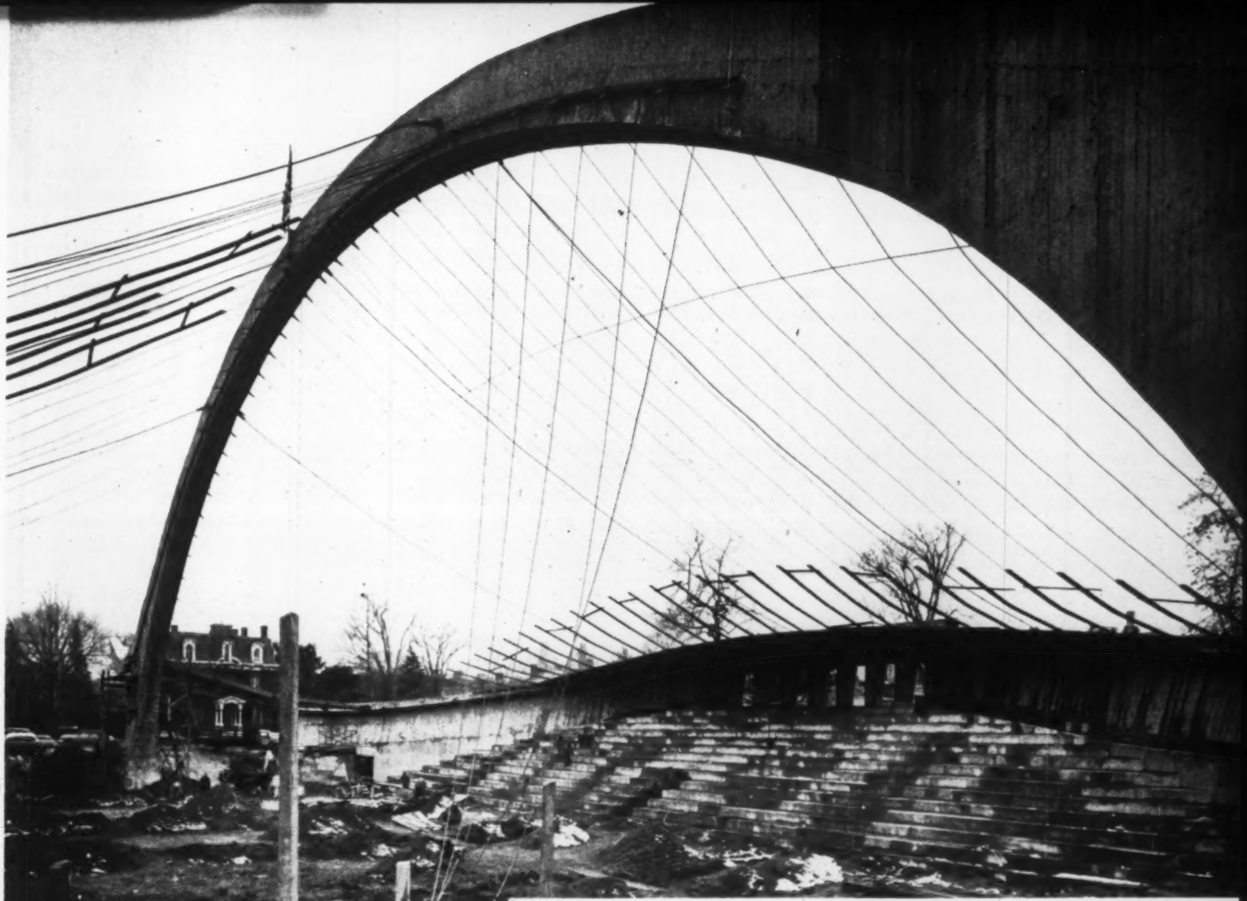
In addition to serving as building enclosures, the curved exterior walls resist roof-cable pulls and earth pressures. The earth pressures, readily obtained by recognized formulas, result from earth compacted along the outside of the walls, 20 ft high at the center, and falling off slightly towards the ends of the walls.

The critical roof load for all components of the walls was found to be the maximum load on the entire roof. Unsymmetrical live loads generally create critical loading conditions on parts of a structural element shaped like this wall, but the preloading of the roof in this case eliminated such a loading condition. For a symmetrical uniform roof load, the horizontal components of all the cable pulls are equal. The maximum horizontal cable pull is 32 kips.

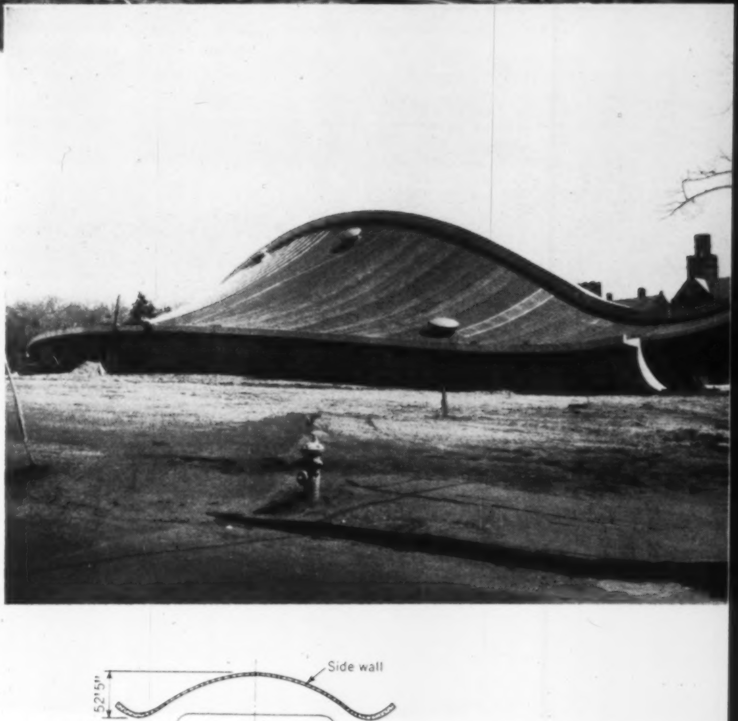
Poured monolithically, each of the

FIG. 1. Quarter floor-plan of rink building shows arrangement of column-free area, which includes hockey rink, three thousand seats, and entrance ramps. Clear distance between arch buttresses is 228 ft.



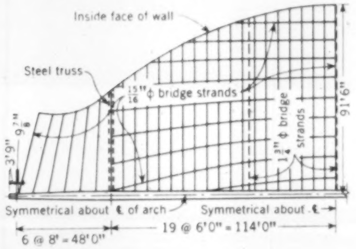


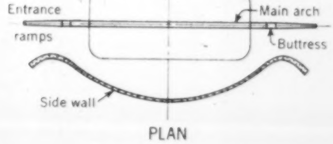
Curves for appearance as well as for structural functions are featured in David S. Ingalls Rink, 1.1-million-dollar structure recently completed at Yale University. Cables running both transversely and longitudinally are covered by roof.



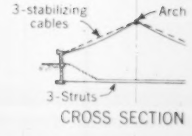
Roof deck consists of random lengths of tonque-and-groove planks nailed to nailers, which in turn are bolted to the cables. See Fig. 4. Exterior walls are 183 ft apart at center and 78 ft apart at end glass enclosures. See general plan and cross section, lower right.

FIG. 2. Steel cables suspended between center arch and curved exterior walls support wood-plank roof. The 18 longitudinal cables (9 on each side of the center arch) are prestressed. They act as tie-downs for the roof deck, preload the roof construction, and resist horizontal loads on center arch.


Inside face of wall
Steel truss
$\frac{15}{16}$" ϕ bridge strands
$1\frac{3}{4}$" ϕ bridge strands
3'9"
$9\frac{7}{8}$"
91'6"
Symmetrical about ℄ of arch
Symmetrical about ℄
6 @ 8' = 48'0"
19 @ 6'0" = 114'0"


52'5"
Side wall
Entrance ramps
Main arch
Buttress
Side wall

PLAN


3-stabilizing cables
Arch
3-Struts

CROSS SECTION

two curved walls will act as a unit for any load applied to it. These may be considered as retaining walls 52 ft deep, or rather, as cantilevered shells.

Each wall is topped by a flat concrete section 7 ft wide, and approximately 18 in. high. This section is actually a nearly horizontal parabolic arch to which the roof cables are anchored. The long axis of this arch cross-section is in line with the tangent to the cable curve at the point of anchorage, which is practically horizontal. For reasons of drainage the average slope of these tangents varies from 0 to 4 deg.

This flat concrete section on top of the wall acts exactly as a parabolic arch of this shape and loading would act, at least at the center of the structure. However, as this arch has no fixed supports at its ends, the forces in it must be transferred to the thin wall. It is obvious that the arch is required to resist the great transverse force which the edge of the thin wall could not accommodate. The function of this arch might be roughly compared to that of a stiffener under a concentrated load at the end of a cantilever steel beam. The stiffener transfers the load to the beam web in such a manner that the shearing stresses will have a natural parabolic distribution along the web.

For this wall to act as a true cantilever beam, the shearing forces in the wall must equal the natural shear flow. Generally speaking, the wall was analyzed as a cantilever shell, with the arch on top redistributing the membrane shearing forces and transverse forces into a shear pattern equal to the natural shear flow in a cantilever beam. This function of the arch does introduce considerable bending moments in it. In this structure, however, such bending moments were reduced by the fact that the ends of the walls could be braced by the two floor levels at the entrances, thereby creating a resistance against lateral displacements. Although the loadings on the walls could be expressed by a formula, the shape of the walls themselves created many interesting problems. Each wall varies in height; the upper part slopes 15 percent in a plane normal to the wall; and the elevation of the points of intersection between the sloping and the vertical portions also varies.

The wall foundation is a continuous footing 7 ft wide and 20 in. deep, projecting approximately 5 ft outside the wall. The main function of this footing is to resist the shearing forces in the wall. Except in the center portion, where there is uplift due to beam action, the dead load is considerable, consisting of the weight of the wall, the seats and the earth, so that there is sufficient friction to prevent movement of the foundation. The center portion is held in place by three struts running from wall to wall and a tie between two opposite points on the foundation, approximately 160 ft apart.

Stresses in the main arch are of course designed for the usual dead and live loads, with standard variations in the application of live loads to obtain critical stresses for various sections of the arch. In addition to this usual type of loading, there is also the horizontal loading on the arch created by differing loads on its two sides. This loading condition will be produced by wind blowing normal to the arch, or more serious, by such a wind load combined with a snow load.

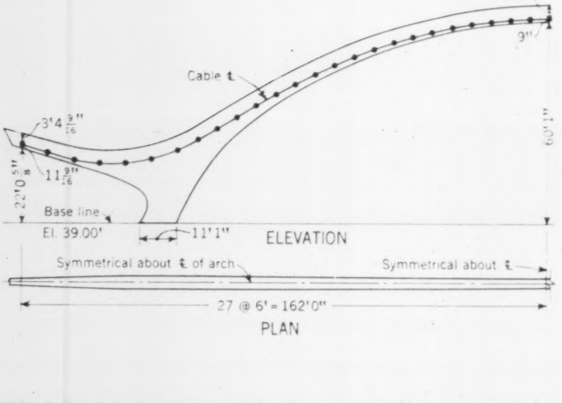
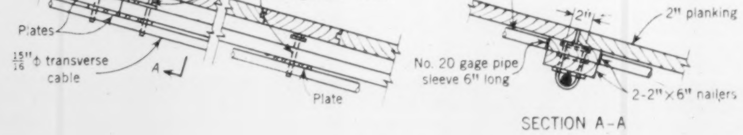


FIG. 3. Center arch, seen in plan and elevation, divides building into two equal parts, rising 75 ft above rink floor at center.

FIG. 4. Roof deck consists of 8 x 2 tongue-and-groove treated wood planks, nailed to 2 x 6 nailers, which in turn are bolted to the cables.


℄ longitudinal cable
Pipe sleeve
$\frac{5}{8}"\phi$ U-bolts with hex nuts
A
$\frac{3}{8}"\phi$ U-bolts midway between longitudinal cables
Plates
$\frac{15}{16}"\phi$ transverse cable
A
Plate
Longitudinal cable
2"
2" planking
No. 20 gage pipe sleeve 6" long
2-2"×6" nailers
SECTION A-A

To illustrate the action of these horizontal loads on the arch, it may be helpful to compare a cable with a conventional truss. The end reactions of a truss are relatively small when compared to the internal forces. A cable is a truss without a top chord or a web system. Consequently, a cable support, in addition to the usual reactions, must also resist a force which is equivalent to the maximum force in the top chord of a truss. It is therefore obvious that the horizontal component of the cable pull is normally several times larger than the vertical component (end reaction) and that the arch would be very sensitive to any unsymmetrical loading.

Three elements resist the horizontal loads on the main arch. First, in order of action, are the pretensioned longitudinal cables. On the windy side, the wind and snow load will relieve the cable tension, while on the lee side the cable tension will be increased. Second are the three bracing cables, which were pretensioned to increase their efficiency. The third and main element resisting horizontal forces is the arch itself, acting as a curved beam. To make it practical to calculate the stresses in the bracing cables and the arch produced by this unbalanced roof loading, the effect of the longitudinal roof cables was calculated separately, and a reduced loading for the bracing cables and the arch was then established.

The magnitude of the horizontal forces taken by the bracing cables was found by calculating the relative deformation of the cables and the arch at the points of attachment. Then, with all the horizontal loads acting on the main arch known, the stresses from bending and torsional moments and shears were calculated as stresses in a nominal curved beam, and combined with the calculated conventional stresses in the arch.

The design, based on a maximum roof (snow) load of 30 lb per sq ft and a maximum wind velocity of 100 miles per hr, resulted in an arch both functional and pleasing to the eye.

Excavation for the foundations was done along the periphery of the building, thus temporily leaving an island in the center of the lot. The wall foundations rest on medium coarse sand,

and the arch foundation rests on a material which may be classified as soft rock, approximately 38 ft below grade.

The arch foundation, footings and A-frame buttresses were poured in three operations, with backfilling and soil compaction following each stage of the construction.

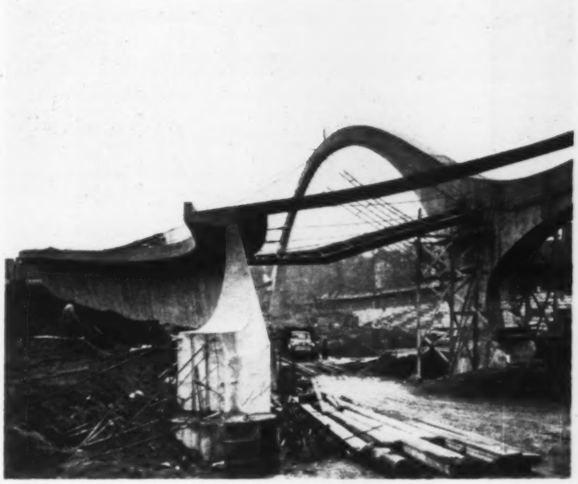
The 16-ft-high unexcavated "island" in the center was of course left for the purpose of reducing the height of the scaffolding supporting the arch formwork, as shown in a photograph. Standard steel scaffolding was used throughout except for a distance of 18 ft at each end of the arch, where the builder elected to use timber shoring, also seen in a photograph. The concrete arch was poured in four operations, one end and one-half of the arch at a time. Side forms were reused. The "island" was later excavated below grade to provide for the skating rink.

Exterior walls were also constructed in three operations. The vertical walls, the seat construction, and the sloping wall with the flat section on top were poured monolithically. Continuity of the walls was maintained by the use of rectangular keys at each construction joint and installation of sloping (45-deg) dowels between the two wall sections. Because of the complexity of the component parts, the laying out of the walls and arch, and the location and setting of cable anchors were very difficult tasks. The final result was very satisfactory, and no undesirable cable adjustments were found to be necessary.

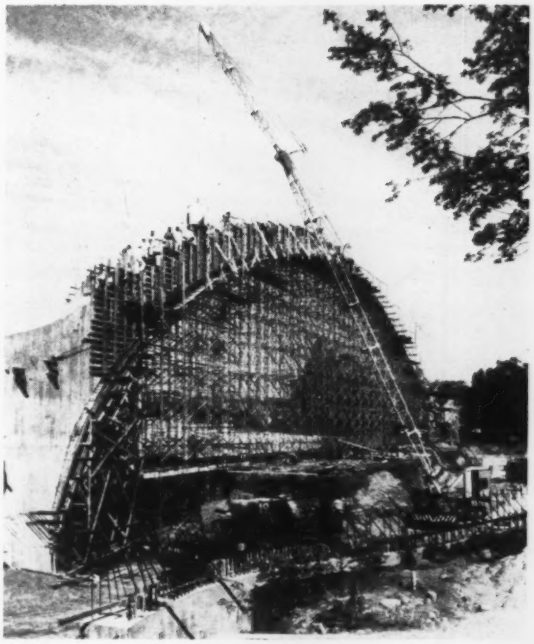
All cables were installed in accordance with theoretical dimensions. The accuracy of the shape of the cables was verified by spot checking the sag of a number of cables.

Placing of the wooden roof deck started at the walls and proceeded toward the arch simultaneously on both sides. The nailers consist of two 2 x 6 planks nailed together after being shaped and bolted to the cables. To prevent excessive distortion of the roof by the application of loads to one end of the cables, longitudinal cables were temporarily placed on the upper half of the roof. Any irregularity appearing after the deck was completely installed was taken out during the pretensioning of the longitudinal cables.

The architectural firm of Eero Saarinen and Associates, Bloomfield Hills, Mich., designed the structure, with Douglas Orr of New Haven as associate architect. The author's firm, Severud - Elstad - Krueger - Associates, served as structural engineers and the firm of Jaros, Baum and Bolles as the mechanical engineers. Geo. B. H. Macomber Co., Boston, was the general contractor.



Steel cables suspended between center arch and the curved exterior walls support wood-plank roof. Note bent steel truss connecting arch buttress to side wall. There are four of these trusses, tying arch to both side walls at each end.



Arch rises 75 ft above rink at center, where its cross section is 3 ft wide by 5 ft high. Both dimensions increase toward the buttresses.

Snowload of 30 psf, plus unbalanced wind load on central arch, were included in the design of this unique structure.

ENGINEERS' NOTEBOOK

Analysis of frames with knee braces

SENG-LIP LEE, A.M. ASCE

Assistant Professor of Civil Engineering, Northwestern University, Evanston, Ill.

In the design of industrial structures, occasions often arise which call for the use of frames with knee braces such as that shown in Fig. 1. The method of analysis here demonstrated may prove useful in the treatment of this type of frame.

The frame, loaded as shown in Fig. 1, is composed of two types of members. Members *ac, ce, eg, am, cn, ep* and *gq* are flexual members of constant and equal *EI*, continuous respectively at points *b, d, f, h, i, j* and *k*, whereas the knee braces *bh, bi, di, dj, fj* and *fk* are two-force members pin-connected at each end. Neglecting the negligible effect of axial deformation, the cross-sectional areas of the members are not involved in the calculation of the bending moments, the shearing forces, the axial forces, and the reactions on the frame.

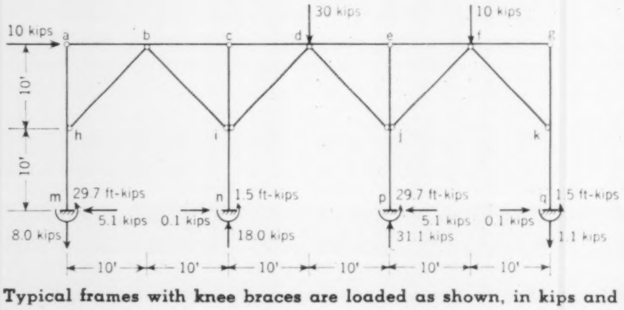

30 kips
10 kips
10 kips
a
b
c
d
e
f
g
10'
10'
h
i
j
k
m
29.7 ft-kips
n
1.5 ft-kips
p
29.7 ft-kips
q
1.5 ft-kips
5.1 kips
0.1 kips
5.1 kips
0.1 kips
8.0 kips
18.0 kips
31.1 kips
1.1 kips
10'
10'
10'
10'
10'
10'

FIG. 1. Typical frames with knee braces are loaded as shown, in kips and ft-kips.

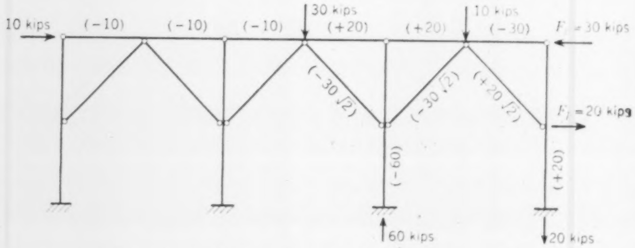

10 kips
(−10)
(−10)
(−10)
30 kips
(+20)
(+20)
10 kips
(−30)
F_g = 30 kips
$(-30\sqrt{2})$
$(-30\sqrt{2})$
$(+20\sqrt{2})$
F_k = 20 kips
(−60)
(+20)
60 kips
20 kips

FIG. 2. To prevent joint translation, two auxiliary forces are introduced, F_g and F_k $\delta_g = \delta_k = 0$. F_g restrains horizontal deflection of joints *a* to *g*, and F_k restrains horizontal deflection of *h, i, j and k* and vertical deflection of joints *b, d* and *f*. Axial forces, N_0, alone exist in this case, indicated in parentheses, in kips.

To determine these quantities, two auxiliary forces F_g and F_k are first introduced (Fig. 2) to prevent joint translation, that is, $\delta_g = \delta_k = 0$. Observe that F_g restrains the horizontal deflection of joints *a* to *g* inclusive while F_k restrains the horizontal deflection of joints *h, i, j* and *k* as well as the vertical deflection of joints *b, d* and *f*. The vertical deflection of joints *a, c, e* and *g* is of course checked by the supports. Since all loads are applied at the joints, axial forces N_0 alone exist in this case; they are indicated in parentheses in Fig. 2, where the corresponding reactions are also shown.

The translation of the structure can take place in two modes, the antisymmetrical mode (Case 1) shown in Fig. 3 and the symmetrical mode (Case 2) shown in Fig. 4. In Case 1, the deflection δ_1 causes bending of the vertical members, which may be treated as two-span continuous members. The distribution factors *r* and the fixed-end moment M_F are recorded in Fig. 3. The latter is chosen for convenience as follows:

$$M_F = -6\left(\frac{EI}{h}\right)\left(\frac{\delta_1}{h}\right) \text{ and } h = 10 \text{ ft}$$

Taking $\delta_1 = 1$ ft and $\frac{EI}{h} = 70$ ft-kips, yields $M_F = -42$ ft-kips.

The distribution and final moments M_1, as well as the corresponding shearing forces V_1 and the axial forces N_1 are indicated in Fig. 3. The horizontal members undergo no bending in this case. Knowing the axial forces and the shearing forces, the reactions and the two auxiliary forces,

$$F_g' = 19.2 \text{ kips and } F_k' = 0$$

can be computed by means of the equilibrium conditions of consecutive joints starting from the left end to the right. $F_k' = 0$ can be deduced from the fact that joint *d*, being on the axis of antisymmetry, does not deflect verti-

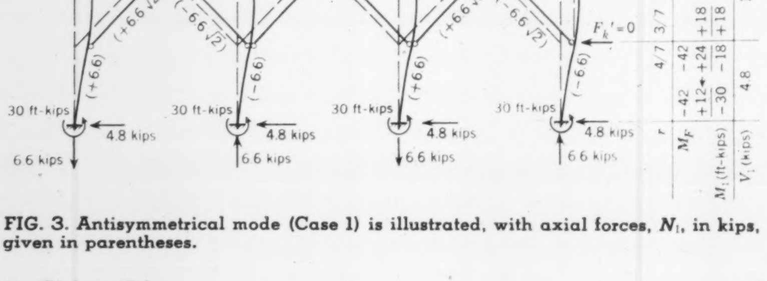

δ_1
(−1.8)
(+11.4)
(+9.6)
(+9.6)
(+7.8)
(+21.0)
F_g' = 19.2 kips
$(+6.6\sqrt{2})$
$(-6.6\sqrt{2})$
$(+6.6\sqrt{2})$
$(-6.6\sqrt{2})$
F_k' = 0
(+6.6)
(−6.6)
(+6.6)
(−6.6)
30 ft-kips
30 ft-kips
30 ft-kips
30 ft-kips
4.8 kips
4.8 kips
4.8 kips
4.8 kips
6.6 kips
6.6 kips
6.6 kips
6.6 kips
r
4/7
3/7
M_F
−42
−42
+12
+24
+18
M_1 (ft-kips)
−30
−18
+18
V_1 (kips)
4.8
1.8

FIG. 3. Antisymmetrical mode (Case 1) is illustrated, with axial forces, N_1, in kips, given in parentheses.

cally. This in turn restrains the horizontal deflection of joint k relative to joint g, and consequently no horizontal force is needed at joint k to produce $\delta_g = \delta_k = \delta_1$.

The forces in Case 2 are determined similarly in Fig. 4. The only additional comment needed in this case is that the vertical deflection of point f and the horizontal deflection of point k are proportional to fg and gk. Since the knee braces are inclined at 45 deg, $\delta_k = \delta_f = \delta_2$.

The forces produced by the loads shown in Fig. 1 are calculated by the following expressions:

Bending moments:

$$M = M_o + M_1\,\delta_1 + M_2\,\delta_2$$

Shearing forces:

$$V = V_o + V_1\,\delta_1 + V_2\,\delta_2$$

Axial forces: $N = N_o + N_1\,\delta_1 + N_2\,\delta_2$

Reactions: $R = R_o + R_1\,\delta_1 + R_2\,\delta_2$

The subscripts 0, 1 and 2 denote respectively the forces shown in Figs. 2, 3, and 4. As explained previously, $M_o = V_o = 0$ in this case.

The values of δ_1 and δ_2 are calculated from the equilibrium equations:

$$F_g'\delta_1 + F_g''\delta_2 - F_g = 0$$
$$-F_k'\delta_1 - F_k''\delta_2 + F_k = 0$$

or

$$19.2\,\delta_1 + 51.0\,\delta_2 - 30 = 0$$
$$-51.0\,\delta_2 + 20 = 0$$

the solution of which yields $\delta_1 = 0.521$ and $\delta_2 = 0.392$. It is obvious from these equations that F_g', F_k', F_g'' and F_k'' are the relative stiffness influence coefficients of the frame.

The final values of the bending moment M in the flexural members and the axial forces N are indicated in Fig. 5, while the reactions R are shown in Fig. 1.

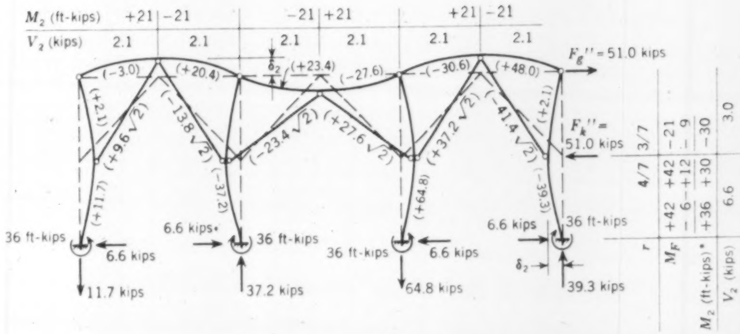


FIG. 4. Symmetrical mode (Case 2) is illustrated here, with axial forces, N_2, in kips, given in parentheses. $\delta_g = 0$: $\delta_k = \delta_2$; $F_g'' = F_k'' = 51.0$ kips. Signs of M_2 starred are for members *cin* and *gkq*. Those for members *ahm* and *ejp* are reversed.

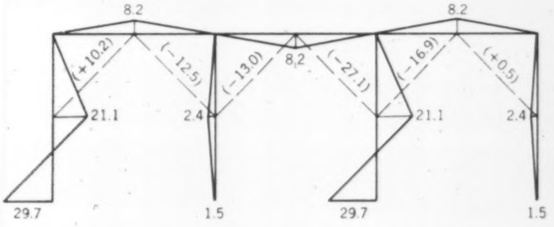


FIG. 5. Final values of bending moment M in flexural members are given in ft-kips. $M = M_1\,\delta_1 + M_2\,\delta_2$ plotted on tension sides. Axial forces, in parentheses, are in kips. $N = N_o + N_1\,\delta_1 + N_2\,\delta_2$.

The general case where intermediate transverse loads are applied on the members presents no new problem other than the calculation of M_o and V_o, which can be incorporated in Fig. 2. In cases where the knee braces in the same bay do not meet at a common joint on the horizontal member, the same procedure can be applied, the only difference being the increased numbers of modes of translation and the consequent increase in the numbers of auxiliary forces and equilibrium equations needed to obtain a solution.

THE READERS WRITE

Limited deflection of beam solved by equation

To THE EDITOR: In his article, "Limited deflection of beam by chart," in the July issue (p. 67), T. D. Y. Fok quotes T. C. Shedd's equation correlating the deflection with the other physical properties of a beam and gives a nomograph of the equation for one condition of loading and support.

In my own practice, I have found it more convenient to express this equation in the following manner:

$$\frac{L}{d} = q\left(\frac{c_M}{24c_D}\right)\left(\frac{E}{S}\right)$$

in which

L = length in feet

d = depth of beam in inches

q = deflection-span ratio (1/360 for plaster)

c_M = moment coefficient for loading and support

c_D = deflection coefficient for loading and support

E = modulus of elasticity (psi)

S = maximum unit stress (psi)

For uniform loading on a steel beam limited to $q = 1/360$, this equation reduces to:

$$\frac{L}{d} = \frac{33{,}331}{S} \text{ for a simple span}$$

$$\frac{L}{d} = \frac{55{,}553}{S} \text{ for a fixed span}$$

Since the equation is linear, the factors can be changed as required, and the limiting values for the required span, support, material, and other unknowns can be easily determined.

W. A. MCCRACKEN, A.M. ASCE
Consulting Engineer
Houston, Tex.

Students contribute to United Engineering Center

To THE EDITOR: I was very glad to learn, from the July issue of CIVIL ENGINEERING, that another engineering college has made a contribution to the United Engineering Center. However, I would like to call your attention to the fact that the Benton Engineering Society, University of Florida, of which the Student Chapter ASCE is a member, contributed $50.00 to the United Engineering Center on April 22, 1958. The Student Chapter ASCE had a part in this gift.

It was our aim that through this initial token contribution, other colleges would realize the need for everyone's support, however great or small, in the building of the United Engineering Center.

ROBERT BAYLESS
President, ASCE Student Chapter, Univ. of Fla.
Gainesville, Fla.

Inverted stepped footings for savings with safety

To the Editor: The writer sincerely appreciates the comments on his article, "Inverted Stepped Footings for Savings with Safety" (February 1958 issue, p. 76) which have appeared in Civil Engineering, and also those which have been conveyed to him directly.

While the comments have stressed some questionable points, such as taking the shear at a *d* distance from the depression, none came up with a better solution for developing the dowel forces through bond. As we all endeavor to reduce column sizes, high-strength concrete and hard-grade vertical reinforcement for columns are commonplace. Unless an unnecessarily high quality of concrete is used for the footings, such transfer is quite difficult. Often there isn't space for extra dowels.

Pedestals above footings have to be poured in suspended forms, and if these cannot protrude above the floor, the excavation, particularly for interior columns, becomes deeper than necessary. The "good old conventional" footings either do not satisfy the dowel-bond requirements at all, or have to be unnecessarily thick.

The writer does not share the fears that the bottom bars in the depression might slip. Footings have been built for centuries, using stones, bricks, and other materials without metal reinforcement, whereby the dimensions of the footing remained within the pressure cone. While this is not entirely the case with depressed footings, there is an analogy. The footing of the example has, for instance, such a great moment of inertia that the stress in the concrete would not exceed one tenth of f'_c. Under such conditions, the reinforcing is required more to satisfy the code than by necessity. The average bond stress in the bottom No. 9 bars is 145 psi only.

The minor variation shown in the accompanying Fig. 1 is suggested. This variation consists of slightly sloped walls for the depression, as against the vertical walls in the original diagram.

When the columns are spaced 20 ft on centers in each direction, the costs are as given in Table I.

The writer, as a practicing consulting engineer, would be reluctant indeed to ignore such substantial savings with safety.

Paul Rogers, M. ASCE
Consulting Engineer

Chicago, Ill.

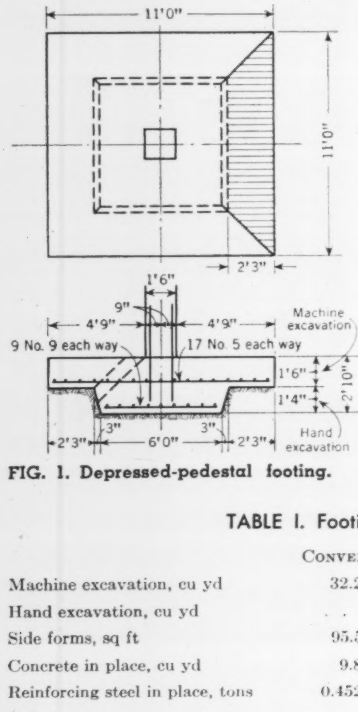


FIG. 1. Depressed-pedestal footing.

TABLE I. Footing costs compared

	Conventional Footing	Depressed Footing
Machine excavation, cu yd	32.2 × 1.00 = 32.2	22.2 × 1.00 = 22.2
Hand excavation, cu yd	. . . .	1.9 × 4.00 = 7.7
Side forms, sq ft	95.5 × 0.40 = 38.2	79.4 × 0.40 = 31.8
Concrete in place, cu yd	9.8 × 16.0 = 156.8	8.6 × 16.0 = 138.4
Reinforcing steel in place, tons	0.452 × 235 = 106.2	0.355 × 235 = 83.3
	333.4	283.4
	− 283.4	
	$50.0 = net saving per footing	

Computing sequent depth on another slide rule

To the Editor: Acceptance of Professor Sarpkaya's handy suggestion, in his article in the July 1958 issue (p. 66), may be limited by the implication that it only works on "any slide rule which has the reciprocal of numbers on the stator directly under the normal graduation (for instance, a Pickett dual-base log-log slide rule)."

Actually, a Keuffel and Esser slide rule works just as well. Take Professor Sarpkaya's Eq. 4 and rearrange it to obtain

$$Ln\,X = Ln\frac{1}{X + Y} + Ln\frac{1}{Y}$$

Using the reciprocal of Y on the D-scale and $1/(X + Y)$ on the CI-scale gives the trial value of X on the D-scale. Professor Sarpkaya's example then follows this pattern:

Set $Y = 1.2$ on the C-scale opposite the left index on the D-scale. Now the right index of the C-scale points to 0.833 on the D-scale, that is, $1/Y$. Assume $X = 0.40$, add $1.20 + 0.40 = 1.60$, and set the cross-hair on 1.60 on the CI-scale without moving the slide. This gives 0.521 on the D-scale for the next trial value of X. Now set $1.200 + 0.521 = 1.721$ on the CI-scale and read 0.484 on the D-scale, which is the second trial value.

The next trial gives 0.495 for X, 1.695 for $X + Y$ and 0.492 for the next trial value of X. This is Professor Sarpkaya's final value.

Henry A. Babcock, A.M., ASCE
Ass't. Prof. of Civil Engineering
Colorado School of Mines

Golden, Colo.

Sequent depth by graph

To the Editor: In the July 1958 issue (p. 66), Turgut Sarpkaya presented an article entitled "Computation of Sequent Depth in Hydraulic Jump Simplified." The method described does appreciably simplify the slide-rule solution of the upstream variables of the hydraulic jump equation. However, the common design problem is to solve for the downstream variables when the velocity and depth entering the jump are given. In either case, the problem can be solved more rapidly with the proper graphs.

In 1933, E. W. Lane, M.ASCE, then with the U. S. Bureau of Reclamation, devised such a graph (Drawing No. X-D-931). The log-log coordinates were V_1 and D_1 while V_2 and D_2 were represented by two families of lines. When any two of the variables are known, the other two can be read directly from the graph.

It is understood that engineers who have had the graph available have used it extensively in the past 25 years. The Bureau of Reclamation's Drawing No. X-D-931 was published on page 105 of *Low Dams* by the National Resources Committee (U. S. Government Printing Office, Washington, 1939).

Marden B. Boyd, J.M. ASCE
Hydr. Engr., Hydr. Analysis
Branch, Waterways Exp. Sta.

Vicksburg, Miss.

Corrected table for peak rates

To the Editor: In reading my articles, "Nation's Capital Enlarges Its Sewerage System," Parts 1 and 2, as printed in the June and July issues, I noticed one error. This occurs in Table VI (July issue, p. 46), where the values for "No. of Persons per Acre" were omitted under the bracket.

The correct table is as follows:

TABLE VI. Hourly peak rates

For design of separate sewers serving residential areas, in gal per capita per day (gcd)

Area, Acres	No. of Persons per Acre				
	10	20	30	40	50
10	1,760	1,230	1,070	970	884
100	1,453	991	822	740	656
1,000	984	670	563	500	446
10,000	546	376	313	280*	251*

*300 gcd used as a minimum actual design rate.

C. Frank Johnson
Senior Engr., Metcalf & Eddy

Boston, Mass.

AMERICAN SOCIETY OF CIVIL ENGINEERS

1958 New York Annual Convention

Hotel Statler-Hilton **October 13-17, 1958**

REGISTRATION

Convention Rotunda, Hotel Statler-Hilton

Opens Sunday, Oct. 12, 2:00 to 5.00 p.m.
Monday, Oct. 13, and each Convention day, 8:30 a.m. to 5:00 p.m.

Registration fee $4.00 (except women and students).

HOTEL ACCOMMODATIONS

Headquarters of the Annual Convention will be the Hotel Statler-Hilton, on Seventh Avenue between 32nd and 33rd Streets, directly opposite and connected to the Pennsylvania Station. Special arrangements have been made to accommodate many Convention visitors at the headquarters hotel, up to capacity, in the order that reservation requests are received. Send your reservation request early to assure space at the headquarters hotel. For your convenience, a special request form is provided on page 128. Late requests may have to be assigned to other nearby hotels.

AUTHORS' BREAKFASTS

East Room Hotel Statler-Hilton

8:15 a.m. each Convention day. Briefing sessions for speakers, discussers and program officials by invitation only. Presiding: Gardner M. Reynolds, Vice Chairman, New York Annual Convention Committee.

ADVANCE INFORMATION ON ATTENDANCE

To assure adequate preparation to make your attendance at the Annual Convention most satisfactory, the Committee requests your assistance. It will be most helpful to have guidance on the number of persons to be expected for the various functions. Will you please use the coupon on page 128, which is to be sent to Thomas J. Fratar, Convention Chairman.

This does not constitute registration. It will be necessary to register when you arrive at the Convention.

Do not send a check covering all events. The only event for which advance payment is required is the Dinner-Dance on Oct. 15, as detailed in the program.

Your help in furnishing this advance information will measurably facilitate the planning of the Committee.

KICKOFF PARTY

Monday, Oct. 13

5:30—7:00 p.m. Ballroom

Cocktails, dancing and entertainment

At this first general gathering of the Convention, the cordial hospitality of the Metropolitan Section will be enjoyed. All who have paid the registration fee, and their wives, are welcome without charge.

CIVIL ENGINEERING SHOW

9:00 a.m. to 6:00 p.m. Mon. through Thurs.

9:00 to 12:30 Friday

Georgian Room, Georgian Foyer Mezzanine and Ivy Suite

Firms supplying materials, equipment and services used in the various fields of civil engineering will participate in the Second Annual Civil Engineering Show. The exhibit will afford an opportunity to observe first hand the latest developments available to the practicing engineer.

MONDAY MORNING

OCT. 13

Construction Division

9:30 a.m. Gold Room

Foreign Construction

Presiding: Walter L. Couse, Chairman Exec. Committee, Construction Div.

9:45 **Place of U. S. Contractors in Overseas Construction**
Henry C. Boschen, M. ASCE, Vice President in charge of Overseas Operations, Raymond International Inc., New York, N. Y.

10:45 **Business Problems and Construction Methods in Australia and India**
George Havas, M. ASCE, Vice President and General Manager, Henry J. Kaiser Co., Oakland, Calif.

11:30 **Discussion**

Eng. Mech., Structural Divs., Joint Session with IABSE

9:30 a.m. Ballroom

Research and Design, Plasticity in Steel

Presiding: Leo H. Corning, Chairman, Exec. Committee, Structural Div.

9:30 **Developing and Application of the Plastic Method of Designing Steel Structures**
John F. Baker, M. ASCE and IABSE, Prof. of Mechanical Sciences and Head, Dept. of Eng., Cambridge Univ., England.

10:10 **Ductility as a Basis for Steel Design**
Lynn S. Beedle, A.M. ASCE, Research Prof., Chairman, Structural Metals Div., Fritz Eng. Lab., Lehigh Univ., Bethlehem, Pa.

10:45 **Some Recent Developments in Plastic Analysis and Design**
Daniel C. Drucker, M. ASCE, Prof. and Chairman, Div. of Eng., Brown Univ., Providence, R. I.

11:15 **Discussion**

Waterways and Harbors Division

9:30 a.m. East Room

Sponsored Jointly by Committee on Research and Committee on Ports and Harbors

Presiding: Roger H. Gilman, Chairman, Exec. Committee, Waterways and Harbors Div.

9:30 **Tidal Navigational Problems Below Wilson Dam**
R. A. Elder, M. ASCE, Head, Hydraulic Operations and Test Section, TVA, Norris, Tenn.

10:00 **Navigation Model Studies of New Ohio River Locks**
Eugene P. Fortson, Jr., M. ASCE, Chief, Hydraulics Div.; and George B. Fenwick, M. ASCE, Chief, Rivers and Harbors Branch, Waterways Exp. Sta., Vicksburg, Miss.

10:30 **Port of Rota, Spain**
Stephen M. Olko, A.M. ASCE, Consulting Engr., New York, N. Y.

11:00 **Terminal for Large Tankers in Central Sumatra**
B. Sylveston, Partner, Tippetts-Abbett-McCarthy-Stratton, New York, N. Y.

URBAN RENEWAL LUNCHEON

Monday, Oct. 13

12:15 p.m. Terrace Ballroom

Greetings from New York: Robert F. Wagner, Mayor, City of New York

Speaker: Hon. Prescott Bush, United States Senator from Connecticut, Member Senate Subcommittee on Housing

Subject: Urban Redevelopment and Renewal

Presiding: Louis R. Howson, President ASCE

Toastmaster: J. Cal Callahan, Chairman, Executive Committee, City Planning Div., ASCE

All members, guests and friends of the Society are invited to attend, sharing the topic of timely concern to the profession.

Per plate, $4.75. Tickets for this event should be purchased before 10.00 a.m. on Monday.

MONDAY AFTERNOON

OCT. 13

Construction Division

2:30 p.m. Gold Foyer

Foreign Construction

Presiding: Walter L. Couse, Chairman, Exec. Committee, Construction Div.

2:30 **The Approach of Management to the Canadian Construction Market**
A. Douglas McKee, President, Perini Limited, Toronto, Ontario, Canada

3:15 **Financing Overseas Construction Work**
Daniel A. Del Rio, Representative, Banco Nacional de Cuba, New York, N. Y.

4:00 **Discussion**

STUDENT CHAPTER CONFERENCE

Monday, Oct. 13

2:15 p.m. Penntop

Presiding: Vincent DeSimone, Chairman, Metropolitan Conf. of Student Chapters

2:15 **Call to order and introduction of Chapter representatives**
Report of attendance by Chapter.

2:30 **Welcoming remarks and introduction of**
Robert H. Dodds, Vice President, Metropolitan Section.
By George A. Burpee, Chairman, Subcommittee on Student Activities, Annual Convention Committee.

2:40 **Presentation of Charters to Metropolitan Student Chapters**
Robert H. Dodds

3:00 **Professionalism for Engineers, Panel Discussion**

(a) **"Why Professionalism in Civil Engineering?"**
Enoch R. Needles, Past President ASCE

(b) **"Are Civil Engineers Professionals?"**
Martin S. Knapp, Field and Supervisory Engr., Port of New York Authority.

(c) **"Can the Civil Engineer's Professional Status Be Improved?"**
Milton Alpern, Consulting Engr. and Prof., Dept. of Civil Eng., Cooper Union School of Eng.

4:00 **Discussion and questions from the floor**

Eng. Mech., Structural Divs., Joint Session with IABSE

2:30 p.m. Ballroom

Research and Design, Ultimate Strength in Reinforced Concrete and Folded Plate Structures

Presiding: Frank Baron, Chairman, United States Council, IABSE, and Member ASCE

2:30 **Effects of Research on Modern American Structural Concrete Design**
Eivind Hognestad, M. ASCE and IABSE, Manager, Structural Development Sect., Portland Cement Assoc., Chicago, Ill.

3:10 **Ultimate and Other Design Criteria for Reinforced and Prestressed Concrete Frames**
A.L.L. Baker, M. IABSE, Prof., Concrete Technology, Imperial College of Science and Technology, Univ. of London, England

3:45 **Design and Economics of Reinforced-Concrete Folded-Plate Construction of Roofs and Floors**
Charles S. Whitney, M. ASCE and IABSE, Partner, Ammann and Whitney, Consulting Engineers, New York, N. Y.

4:15 **Discussion**

Highway, Surveying & Mapping Divs., Joint Session

2:30 p.m. Gold Room

Latest Developments in Photogrammetry and Computers as Applied to Highway Engineering

Presiding: Carl M. Berry, Chairman, Exec. Committee, Surveying and Mapping Div.

2:30 **The Photo Contour Map and Other Related Developments**
Alfred O. Quinn, M. ASCE, Chief Engr., Aero Service Corp., Philadelphia, Pa.

3:00 **Highway Location Studies and Preliminary Design Aided by Integrated Photogrammetry and Electronic Computations**
H. A. Radzikowski, Chief, Div. of Development, Bur. of Public Roads, Washington, D. C.

3:30 **Highway Final Design and Supervision of Construction Aided by Integrated Photogrammetry and Electronic Computations**
John H. Mitchell, A.M. ASCE, Treasurer, Lockwood, Kessler & Bartlett, Inc., Syosset, N. Y.

4:00 **Discussion**

Waterways and Harbors Division

2:30 p.m. East Room

Sponsored by Committee on Coastal Engineering

Presiding: Roger H. Gilman, Chairman Executive Committee, Waterways and Harbors Div.

2:30 **Sand Bypassing at Santa Barbara, Calif.**

R. L. Wiegel, Assoc. Research Engr., Inst. of Eng. Research, Univ. of Calif., Berkeley.

3:00 **Design of Inlets of Natural Bypassing**

Per Brunn, Director, Coastal Eng. Lab., Univ. of Florida, Gainesville.

3:30 **Financing of Sand Bypassing Installations**

Stephen R. Middleton, A.M. ASCE, County Engr., West Palm Beach, Fla.

4:00 **The Sand Bypassing Plant at Lake Worth Inlet, Fla.**

Charles Senour, M. ASCE, Tippetts - Abbett - McCarthy - Stratton, New York, N. Y.

TUESDAY MORNING

OCT. 14

Eng. Mech., Structural Divs., Joint Session with IABSE

9:15 a.m. Ballroom

Model and Analytical Research—Dams and Shells

Presiding: John S. McNown, Chairman, Exec. Committee, Engineering Mechanics Div.

9:15 **Modern Trends in the Design of Italian Arch Dams and Model Confirmation**

Guido Oberti, M. ASCE and IABSE, Prof. of Structural Eng., Polytechnic School of Turin; Director, Experimental Inst. for Models and Structures, Bergamo, Italy.

9:50 **Application of Shell Theory to Arch Dams**

Alfred L. Parme, M. ASCE, Manager, Structural and Railways Bur., Portland Cement Assoc., Chicago, Ill.

10:25 **Theory and Research in Concrete Shell Design**

A. M. Haas, M. IABSE, Prof., Concrete and Concrete Construction, Inst. of Tech., Delft, Netherlands.

10:40 **Discussion**

Highway Division

9:30 a.m. Gold Room

Sponsored by Committee on Traffic Engineering

Presiding: Wilbur S. Smith, Chairman, Committee on Traffic Eng., Highway Div.

9:30 **Operational Aspects of Controlled-Access Highways**

Joseph E. Havenner, A.M. ASCE, President, Inst. of Traffic Engineers, Automobile Club of Southern Calif., Los Angeles.

10:00 **Panel discussion**

Moderator: Burton W. Marsh, M. ASCE, Dir. of Traffic Eng. & Safety, Amer. Automobile Assoc., Washington, D. C.

Panel members:

J. P. Mills, Jr., Traffic and Planning Engr., Virginia Dept. of Highways, Richmond, Va.

T. T. Wiley, M. ASCE, Commissioner, Dept. of Traffic, New York, N. Y.

D. Grant Mickle, M. ASCE, Director, Traffic Eng. Div., Automotive Safety Foundation, Washington, D. C.

George W. Barton, M. ASCE, Senior Traffic Engr., George Barton & Assocs., Evanston, Ill.

10:50 **Discussion**

Hydraulics Division

9:30 a.m. East Room

Sponsored by Committee on Tidal Hydraulics

Presiding: W. M. Lansford, Member, Exec. Committee, and E. P. Fortson, Chairman, Committee on Tidal Hydraulics.

9:30 **Investigations of Sediment Transportation and Deposition in St. Lawrence River in Vicinity of Traverse Spit**

Raymond Boucher, M. ASCE, Ecole Polytechnique, Montreal, Quebec, Canada.

10:00 **Tidal Characteristics from Harmonic Constants**

Bernard Zetler, Chief, Currents and Oceanography Branch, Tides and Currents Div., U. S. Coast and Geodetic Survey, Washington, D. C.

10:30 **Some Unusual Aspects of Tidal Movement in Wingah Bay, South Carolina**

Harris B. Stewart, Jr., U.S.C & G.S., Washington, D. C.

Surveying and Mapping Division

9:30 a.m. West Room

Surveying Comes of Age

Presiding: Carl M. Berry, Chairman, Exec. Committee, Surveying & Mapping Div.

9:30 **Report of Task Committee on Status of Surveying and Mapping**

Brother B. Austin Barry, A.M. ASCE, Assoc. Prof. of Civil Eng., Manhattan College, New York, N. Y.

10:00 **Airborne Velocity and Distance Measuring Devices Based on Doppler Principle, with Particular Application to Airborne Surveying Operations and Position Determination**

L. R. Chapman, Jr., Head, Flight Test Dept., Avionics Eng. Div. of General Precision Lab., Inc., Pleasantville, N. Y.

10:30 **Comparative Accuracies of Field and Photogrammetric Highway Surveys**

Lewis A. Dickerson, M. ASCE, Partner, Sargent - Webster - Crenshaw & Folley, Architect-Engr. Assocs., Watertown, N. Y.

11:00 **Shape of the Earth as Determined from Artificial Satellites**

John Aloysius O'Keefe, Chief, Research and Analysis Branch, Geodetic Div., Army Map Service, Washington, D. C.

INTERNATIONAL ENGINEERING LUNCHEON

Tuesday, Oct. 14

12:15 p.m. **Terrace Ballroom**

Presiding: John I. Parcel, Hon. M. ASCE, and Vice President, IABSE

Welcome: Louis R. Howson, President of ASCE.

Response: Fritz Stussi, President of IABSE.

For this function of general concern to all engineers, all members, guests and friends of the Society are invited.

Per plate, $4.75.

Tickets for this event must be purchased before 10:00 a.m. on Tuesday.

TUESDAY AFTERNOON

OCT. 14
City Planning Division

2:00 p.m. Gold Foyer

Panel Discussion on Professional Registration

***Presiding:** E. B. Mansur, Member, Exec. Committee, City Planning Div.*

2:00 Frederick P. Clark, Chairman, Committee on Professional Status and Practices, and Past President, Amer. Inst. of Planners.

Dennis O'Harrow, Exec. Director, Amer. Soc. of Planning Officials.

E. Lawrence Chandler, Asst. Secretary, ASCE.

Paul H. Robbins, Exec. Director, Amer. Soc. of Prof. Engineers.

Construction Division

2:30 p.m. West Room

Presiding: John J. Senesy, Chairman, Committee on Session Programs, Construction Div.

2:30 **Management of Industrial Building Projects**

E. Warren Bowden, M. ASCE, Exec. Vice-President, Walter Kidde Constructors, New York, N. Y.

3:15 **Building a New Romanesque Church and Reerecting a Seventh Century Old One**

Charles A. Selby, M. ASCE, President, Vermilya-Brown Co., New York, N. Y.

4:00 **Discussion**

Eng. Mech., Structural Divs., Joint Sessions with IABSE

2:30 p.m. Ballroom

Research in Dynamics and Fatigue of Metals

Presiding: Robert D. Dewell, Member, Exec. Committee, Structural Div.

2:30 **Correlation of Suspension Bridge Behavior with Predictions from Model Tests and Theoretical Analysis**

George S. Vincent, M. ASCE and IABSE, Principal Bridge Engr., Design, Div. of Physical Research, Bur. of Public Roads, Washington, D. C.

3:05 **Behavior of Structures During Earthquakes**

George W. Housner, A.M. ASCE and IABSE, Prof., Applied Mechanics, Calif. Inst. of Technology, Pasadena.

3:40 **Use of High-Speed Computer in Structural Dynamics: Shock, Vibration, Earthquake and Blast**

Nathan M. Newmark, M. ASCE and IABSE, Prof. and Head, Dept. of Civil Eng., Univ. of Illinois, Urbana.

4:10 **Theory and New Test Results on Fatigue of Metals**

Fritz Stussi, President, IABSE, Prof., Wood and Steel Construction, Swiss Federal Inst. of Technology, Zurich, Switzerland.

4:40 **Discussion**

Highway Division

2:30 p.m. Gold Room

Sponsored by Committee on Maintenance and Operation

Presiding: William A. McWilliams, Chairman, Exec. Committee, Highway Div.

2:30 **Electronic Controls for Traffic on Limited Access Highways**

Alger F. Malo, Director, Dept. of Streets and Traffic, Detroit, Mich.

3:00 **Problems of Keeping Traffic Moving During Periods of Adverse Weather**

Edmund R. Ricker, M. ASCE, Traffic Engr., New Jersey Turnpike Authority, New Brunswick, N. J.

3:30 **Problems of Performing Routine Maintenance on a Highway Carrying Large Volumes of High-Speed Traffic**

Conrad H. Lang, M. ASCE, Chief Engr., New York State Thruway Authority, Albany, N. Y.

4:00 **Discussion**

Hydraulics Division

2:30 p.m. Washington Room

Sponsored by Committee on Flood Control and Committee on Hydrology

Presiding: W. M. Lansford, Member Exec. Committee; H. Alden Foster, Chairman, Committee on Flood Control; and W. E. Hiatt, Chairman, Committee on Hydrology, Hydraulics Div.

2:30 **Flood Control Aspects of Cauca Valley Development**

Carlos S. Ospina, M. ASCE, OLAP, Bogota, Colombia, and Phillip Z. Kirpich, M. ASCE, Tippetts-Abbett-McCarthy-Stratton, Cali, Colombia, S. A.

3:00 **Flood Studies in Upper Orinoco Basin of Venezuela**

H. R. Byers and Herbert Riehl, Univ. of Chicago, and Olin Kalmbach, A.M. ASCE, Tipton & Kalmbach, Denver, Colo.

3:30 **An Engineering Appraisal of Hydrologic Data**

D. W. Van Tuyl, M. ASCE, Water Resources Asst., Chamber of Commerce of the U. S., Washington, D. C.

Waterways and Harbors Division

2:30 p.m.

Sponsored by Committee on Navigation and Flood Control Facilities

Presiding: Roger H. Gilman, Chairman, Exec. Committee, Waterways and Harbors Div.

2:30 **Passamaquoddy Tidal Power—a New Source of Energy**

Alden K. Sibley, M. ASCE, Brig. Gen., U. S. Army, Div. of Eng., Corps of Engineers, Boston, Mass.

3:00 **New York State Barge Canal System**

John W. Johnson, M. ASCE, Supt., Dept. of Public Works, State of New York.

3:30 **Terminal Docking Facilities for Super Tankers**

A. D. Quinn, M. ASCE, Vice President and Chief Engr., Frederick Snare Corp., New York, N. Y.

4:00 **Deepening of Existing Wilson Lock Eliminates Third Lockage**

W. F. Emmons, M. ASCE, Head Civil Engr., and O. Lavik, M. ASCE, Civil Design Engr., TVA, Knoxville, Tenn.

CONSULTANTS' DINNER

Tues., Oct. 14, Waldorf Astoria Hotel

Annual Dinner of the American Institute of Consulting Engineers

6:30 p.m. Cocktails, Empire Room

7:15 p.m. Dinner Sert Room

Presiding: Herschel H. Allen, President, Amer. Inst. of Consulting Engineers.

Award of Merit Recipient: James R. Killian, Special Asst. to the President, for Science and Technology.

Cost per person: $19.00.

Engineers who wish to attend may address inquiries about tickets to: American Institute of Consulting Engineers, 33 West 39 St., New York 18, N. Y.

WEDNESDAY MORNING

OCT. 15

Annual business meeting of ASCE

10:00 a.m. Gold Ballroom

Presiding: Louis R. Howson, President of ASCE

10:00 **Annual Reports**
By the President
By the Executive Secretary

10:20 **Presentation of Awards**

10:50 **Installation of Officers**
Report of Tellers on Ballot Canvass
Installation of Directors
Installation of Vice Presidents
Installation of President
President's Keynote Address

12:00 **Adjournment for Awards Luncheon**

AWARDS LUNCHEON

Wed., Oct. 15

12:15 p.m. Ballroom

Speaker: Hon. Ralph Flanders, U. S. Senator, Vermont.

Subject: Problems Facing Engineering Education—the View from Washington.

Presiding: President ASCE

Toastmaster: Thomas J. Fratar, M. ASCE, Chairman, New York Annual Convention Committee.

Honorary Membership Awards presented to:

Henry J. Brunnier, M. ASCE, Consulting Engineer, San Francisco, Calif.

Nathan W. Dougherty, M. ASCE, Dean Emeritus, Coll. of Eng., Univ. of Tennessee, Knoxville.

A M Rawn, M. ASCE, Chief Engr. and General Manager, Los Angeles County Sanitary Dist., Los Angeles, Calif.

For this event all members, their wives, guests and friends of ASCE are invited to attend.

Per plate $4.75. Tickets for this luncheon must be purchased before 10:00 a.m. on Wednesday.

WEDNESDAY AFTERNOON

OCT. 15

Conditions of Practice

2:00 p.m. Gold Ballroom

Presiding: Norman R. Moore, Chairman, Dept. of Conditions of Practice

2:00 **Importance of Emphasis in Civil Engineering Education**
L. E. Grinter, M. ASCE, Dean, Univ. of Florida, Gainesville.

2:30 **Importance of Balance in Engineering Education**
J. B. Wilbur, M. ASCE, Prof., Civil Eng., Mass. Inst. of Technology, Cambridge.

3:00 **The E.C.P.D. Accreditation Program**
F. C. Lindvall, Chairman, ECPD Accreditation Committee, Calif. Inst. of Technology, Pasadena.

3:30 **Mankind Faces a Technological Culture**
M. G. Salvadori, M. ASCE, Prof., Columbia Univ., New York, N. Y.

Hydraulics Division

2:00 p.m. Washington Room

Sponsored by Committee on Hydromechanics

Presiding: W. M. Lansford, Member, Exec. Committee, and D. R. F. Harleman, Chairman, Committee on Hydromechanics, Hydraulics Div.

2:00 **Introductory Remarks**
Donald R. F. Harleman, Chairman, Committee on Hydromechanics, Hydraulics Div.

2:10 **Resistance Experiments in a Triangular Channel**
C. J. Posey, M. ASCE, Director, Rocky Mountain Hydraulic Lab., and Head, Dept. of Civil Eng., State Univ. of Iowa, Iowa City; and R. W. Powell, M. ASCE, Emeritus Prof. of Eng. Mechanics, Ohio State Univ., Columbus.

2:30 **The Effect of Free-Surface Instability on Channel Resistance**
H. J. Koloseus, A.M. ASCE, Hydraulic Engr., U. S. Geological Survey, Iowa Inst. of Hydraulic Research, Iowa City.

2:50 **Resistance Experiments in an Alluvial-Bed Channel**
D. B. Simons, A.M. ASCE, and H. V. Richardson, Hydraulic Engrs., U. S. Geological Survey, Colo. State Univ., Ft. Collins, Colo.

3:10 **Recess**

3:20 **Panel discussion on Frictional Resistance in Open Channels**

The Experimental Viewpoint
E. M. Laursen, A.M. ASCE, Research Engr., Iowa Inst. of Hydraulic Research, Iowa City.

The Analytical Viewpoint
A. T. Ippen, M. ASCE, Prof., Mass. Inst. of Technology, Cambridge, Mass.

The Engineering Practice Viewpoint
Julian Hinds, M. ASCE, Consulting Engr., Santa Paula, Calif.

General discussion from the floor

City Planning, Highway Divisions, Joint Session

2:30 p.m. Gold Foyer

Cooperative Planning for Urban Expressways

Moderator: J. Cal Callahan, Chairman, Exec. Committee, City Planning Div.

Panel Members:

Norman Kennedy, M. ASCE, Asst. Director, Inst. of Transportation & Traffic Eng., Univ. of Calif., Berkeley.

Fred W. Tuemmler, A.M. ASCE, F. W. Tuemmler & Assocs., Hyattsville, Md.

Thomas H. Cutler, M. ASCE, Engr. Manager of Urban Development, Kentucky Dept. of Highways, Frankfort, Ky.

Roger L. Creighton, Asst. Director, Chicago Area Transportation Study, Chicago, Ill.

David S. Johnson, Asst. Chief of Planning, Conn. State Highway Dept., Hartford, Conn.

John S. Tsaguris, A.M. ASCE, Assoc. Planning Director, Tucson City-County Planning Dept., Tucson, Ariz.

4:00 **Discussion**

Power Division

2:30 p.m. West Room

Civil Engineering Features of Thermal Power Plants

Presiding: G. R. Strandberg, Chairman, Exec. Committee, Power Div.

2:30 **Prospecting for a Site**
Reed A. Elliot, M. ASCE, Chief Water Control Planning Engr., TVA, Knoxville, Tenn.

3:10 **Discussion**

3:20 305,000-kw Extension to the Fisk Steam Electric Station

Merle H. Goedjen, M. ASCE, Supervising Design Engr., Commonwealth Edison Co.; John P. Roche, Chief Structural Engr., Naess & Murphy; and Richard M. Collins, Sr. Civil Engr., Bechtel Corp.

4:00 Discussion

4:10 Civil Engineering Features of TVA Steam Electric Stations

George P. Palo, M. ASCE, Asst. Chief Engr.; Walter F. Emmons, M. ASCE, Head Civil Engr.; and Nathan E. Way, M. ASCE, Principal Structural Engr., TVA.

4:50 Discussion

5:00 Las Morochas Gas Turbine Power Plant

A. J. Michael, A.M. ASCE, Structural Engr., The J. G. White Eng. Corp., New York, N. Y.

Sanitary Eng. Division

2:30 p.m. East Room

Sewage-Sludge Treatment and Disposal

Presiding: Richard R. Kennedy, Chairman, Exec. Committee, Sanitary Eng. Div.

2:30 Efficient Processing of Raw Sewage Sludge at Waterbury, Conn.

Walter M. Kunsch, Supt., Waste Disposal, Waterbury, Conn.

3:15 Twenty Years of Sludge Burning at Barberton, Ohio

Charles G. Pettit, Supt. of Public Works, Barberton, Ohio.

4:00 New Developments in Sewage-Sludge Treatment

Frederick G. Nelson, M. ASCE, Director of Sanitary Eng. Technology Div.; and William E. Budd, A.M. ASCE, Manager, Development Sect., Sanitary Eng. Technology Div., Dorr-Oliver, Inc., Stamford, Conn.

Soil Mechanics and Foundations Division

2:00 p.m. Gold Room

Sponsored by Committee on Frost Action and Permafrost

Presiding: R. E. Fadum, Chairman, Exec. Committee, Soil Mechanics and Foundations Div.

2:00 A Study of Building Foundations on Permafrost

M. S. Kersten, A.M. ASCE, Prof., Civil Eng., Univ. of Minnesota, Minneapolis; and E. F. Lobacz, Soils Engr., Arctic Construction and Frost Effects Lab., U. S. Army Engineer Div., Boston, Mass.

2:30 Pile Construction in Permafrost

J. A. Pihlainen, Div. of Building Research, National Research Council, Ottawa, Ontario.

3:00 The Application of Fundamentals of Rock Mechanics to Blasting in Frozen Ground

C. W. Livingston, U. S. Army Snow, Ice and Permafrost Research Establishment, Corps of Engineers, Wilmette, Ill.

4:00 Discussion of Mr. Livingston's paper

W. K. Boyd, Chief, Frozen Ground Applied Research Branch, U. S. Army Snow, Ice and Permafrost Research Establishment, Wilmette, Ill.

DINNER-DANCE AND RECEPTION

Wed., Oct. 15 **Ballroom Suite**

6:30 p.m. Assembly and cocktails in Ballroom Rotunda

Cocktails provided through the hospitality of the Metropolitan Section, ASCE

7:30 p.m. Dinner in Ballroom

9:00 p.m. Reception by President and Honorary Members in East Room

9:00 p.m. Dancing in Ballroom

For this social evening, special reservations can be made for tables seating 10 persons each. Members may underwrite complete tables, or pool reservations with others.

The published seating list will close at 2:00 p.m., Tuesday, Oct. 14. Tickets purchased after that hour will be assigned to tables in order of purchase. Sale of tickets will be limited to the capacity of the Ballroom.

Dinner dress (black tie). Per plate $10.00.

Mail orders for tables must be accompanied by a check in full, and a list of guests. Send order and checks to:

American Society of Civil Engrs.
33 West 39 Street
New York 18, N. Y.

THURSDAY MORNING

OCT. 16

Hydraulics Division

9:30 a.m.

Sponsored by Committee on Hydraulic Structures

Presiding: W. M. Lansford, Member Exec. Committee, and J. H. Douma, Chairman, Committee on Hydraulic Structures

9:30 Spillway Design for Pacific Northwest Projects

Marvin J. Webster, M. ASCE, Head, Hydraulics Sect., Portland Dist., Corps of Engineers, Portland, Oreg.

10:00 The Upper Colorado River Projects.

L. G. Puls, M. ASCE, Chief Designing Engr., Bur. of Reclamation, Denver, Colo.

10:30 Hydraulic Analysis of Surge Tanks by Digital Computer

Nicholas L. Barbarossa, M. ASCE, Head, Hydraulics Sect., Missouri River Div., Corps of Engineers, Omaha, Nebr.

Eng. Mech., Soil Mech. and Foundations Divs., Joint Session

9:30 a.m. Gold Room

Physico-Chemical Properties of Soils

Presiding: G. A. Leonards, Member, Committee on Mechanical Properties of Materials, Eng. Mechanics Div.

9:30 Clay Minerals

R. E. Grim, Research Prof. of Geology, Univ. of Illinois, Urbana.

10:25 Discussion

P. F. Kerr, Prof. of Mineralogy, Columbia Univ., New York, N. Y.

10:50 Ion-Exchange Phenomena

A. W. Taylor, Assoc. Prof. of Ceramic Technology, Pennsylvania State Univ., University Park, Pa.

11:40 Discussion

P. F. Low, Prof. of Agronomy, Purdue Univ., Lafayette, Ind.

Eng. Mech., Structural Divs., Joint Session with IABSE

9:30 a.m. Ballroom

Stability Considerations in Metal Structures

Presiding: George Winter, M. ASCE, and Member, Permanent Committee of IABSE

9:30 **Stability Considerations in the Design of Steel Structures**

C. E. L. Massonnet, M. IABSE, Prof. Theoretical and Applied Mechanics, Univ. of Liege, Belgium.

10:05 **New Aspects Concerning Inelastic Instability of Steel Structures**

Bruno Thurlimann, A.M. ASCE and IABSE, Research Prof., Civil Eng., Lehigh Univ., Bethlehem, Pa.

10:40 **Some Stability Problems Concerning Compressed Steel Members and Arch Bridges**

Georg Wastlund, Member, Exec. Committee and Technical Adviser IABSE; Prof., Bridge Building and Structural Eng., Royal Inst. of Technology, Stockholm, Sweden.

11:10 Discussion

Pipeline, Highway Divisions, Joint Session

9:30 a.m.

Presiding: A. E. Poole, Chairman, Exec. Committee, Pipeline Div.

9:30 **Crossings Under Highways and Railroads by the Boring Method**

James C. Fisher, M. ASCE, Senior Engr., Consolidated Edison Co. of New York.

10:00 **Policy and Procedure of the Bureau for Utility Relocation and Reimbursement**

G. M. Williams, M. ASCE, Commissioner of Eng., Bur. of Public Roads, Washington, D. C.

10:30 **Lets Look at Safety Records of Natural Gas Pipelines**

Stanley Owens, Transcontinental Gas Co.

11:00 **"Pipeline," motion picture**

Saga of pipelines and the men who build and operate them.

Power Division

9:30 a.m. West Room

Presiding: J. F. Bonner, Incoming Chairman, Exec. Committee, Power Div.

9:30 **Civil Engineering Features of the Arthur Kill Steam-Electric Station**

T. R. Galloway, M. ASCE, Structural Engr., Consolidated Edison Co. of New York, Inc.

10:05 Discussion

10:10 **Site Studies for a Steam Power Plant**

R. D. Chellis, M. ASCE, and Emory Ireland, M. ASCE, Structural Engrs., Stone and Webster Eng. Corp., Boston, Mass.

10:45 Discussion

11:00 **Civil Engineering Features of the Thos. H. Allen Electric Generating Station**

Peter J. McCoy, Chief Civil Engr.; and Vincent Shamamian, M. ASCE, Supervising Civil Engr., Burns and Roe, Inc., New York, N. Y.

11:40 Discussion

Sanitary Eng. Division

9:30 a.m. East Room

Panel Discussion on Procedures and Economics of Sludge Disposal in Coastal Cities

Moderator: Arthur D. Caster, Secretary, Exec. Committee, Sanitary Eng. Div.

Norman B. Hume, M. ASCE, Asst. Director, Bur. of Sanitation, Los Angeles, Calif.

Samuel S. Baxter, M. ASCE, Chief Engr., Bur. of Eng., Philadelphia, Pa.

Roy W. Morse, A.M. ASCE, City Engr., Seattle, Wash.

William A. O'Leary, M. ASCE, Director, Div. of Sewage Disposal, Dept. of Public Works, New York, N. Y.

Guy E. Griffin, A.M. ASCE, Deputy Commissioner, Dept. of Public Works, Westchester County, White Plains, N. Y.

GENERAL MEMBERSHIP LUNCHEON

In Honor of Dr. Karl Terzaghi on the occasion of his 75th Birthday

Thurs., 12:15 p.m. Terrace Ballroom

Speaker: Dr. Karl Terzaghi, Hon. M., ASCE, Prof., Civil Eng., Harvard Univ., Cambridge, Mass.

Subject: Soil Mechanics in Action

Toastmaster: Arthur Casagrande, M. ASCE, Prof., Soil Mechanics and Foundation Eng., Harvard Univ., Cambridge, Mass.

All members, guests and friends of ASCE are invited to attend and take part in this event honoring one of the distinguished engineers of the day.

Per plate, $4.75.

Tickets must be purchased before 10:00 a.m. on Thursday.

POWER DIVISION FIELD TRIP

Thurs., Oct. 16, 1:30 p.m.

Visit to Arthur Kill Generating Station of Consolidated Edison Co. of New York, Inc.

Buses will leave the 32nd St. entrance of the Hotel Statler at 1:30 p.m. sharp to take those desiring to inspect the Arthur Kill Generating Station of Consolidated Edison Co. of New York, Inc. The station is located in Travis, Staten Island, on the Arthur Kill opposite the Rahway River. Unit No. 2 is now under construction and when completed will represent an increase of about 8 percent in system capacity. The B. & W. boiler will deliver steam at 2000 psi at 1050 deg F and will be coal fired, with oil provided for emergency use. The G. E. turbogenerator unit will deliver 335,000 kw at 80 percent power factor. Coal will be delivered by rail; treated city water will be used for boiler make-up. The site has been planned to provide space for five future units and to permit possible future fuel delivery by water.

Buses will return by way of the Staten Island Ferry to the Statler Hotel at 5:00 p.m.

Price per person, $2.50

SANITARY ENGINEERING DIVISION FIELD TRIP

Thurs. afternoon, Oct. 16

Buses will leave the Hotel Statler at 2:00 p.m. to visit the New York City, Bowery Bay Sewage Treatment Plant.

The Bowery Bay Plant capacity has recently been increased from 40 to 120 mgd. Plant facilities include aerated grit chambers, preliminary sedimentation tanks, aeration tanks, final sedimentation tanks, sludge concentration tanks, and digesters. The sludge concentration tanks and digesters, designed on the basis of experimental work for high-rate digestion, are of particular interest. One of the barges used to transport digested sewage sludge to sea will be docked for inspection.

Buses will return to the Hotel Statler at approximately 5:30 p.m. Price per person is $1.50. Tickets must be purchased by 10:00 a.m. Thursday.

THURSDAY AFTERNOON

OCT. 16

Construction, Eng. Mech., Structural Divs., Joint Session with IABSE

2:15 p.m. Ballroom

Prestressed Concrete and Concrete Bridges

Presiding: Dan H. Pletta, Member, Exec. Committee, Eng. Mechanics Div.

2:15 Recent Developments and Research Activities in Prestressed Concrete in Europe

Yves Guyon, M. IABSE, Technical Director, Technical Soc. for the Utilization of Prestress, Paris, France.

2:50 Recent Developments and Research in Reinforced and Prestressed Concrete in Great Britain

Frederick S. Snow, M. ASCE and IABSE, Principal, Frederick S. Snow and Partners, Consulting Engrs., London, England.

3:25 Research and Design of Prestressed Concrete Slabs and Shells in the United States

T. Y. Lin, M. ASCE and IABSE, Prof. Civil Eng., and Research Engr., Inst. of Transportation and Traffic Eng., Univ. of California, Berkeley.

3:55 Recent Advances and Research in the Design and Behavior of Concrete Arch Bridges

Hubert Rusch, M. IABSE, Prof., Reinforced Concrete and Bridge Building, Director, Lab. for Testing Building Materials and Structures, Inst. of Technology, Munich, Germany.

4:25 Discussion

Eng. Mech., Soil Mech. and Foundations Divs., Joint Session

2:00 p.m. Gold Room

Physico-Chemical Properties of Soils

Presiding: Ralph B. Peck, Member, Exec. Committee, Soil Mech. and Foundations Div.

2:00 Soil-Water System

I. Th. Rosenquist, Prof., Univ. of Oslo, and Head of Geochemical Dept., Norwegian Geotechnical Inst., Oslo, Norway.

2:50 Discussion

A. S. Michaels, Assoc. Prof. and Assoc. Director, Soil Stabilization Lab., Mass. Inst. of Technology, Cambridge.

3:15 Engineering Applications

T. W. Lambe, A.M. ASCE, Assoc. Prof. and Head, Div. of Soil Eng., Mass. Inst. of Tech., Cambridge.

4:05 Open discussion

Hydraulics Division

2:30 p.m. West Room

Sponsored by Committee on Hydraulic Structures

Presiding: W. M. Lansford, Member, Exec. Committee, and J. H. Douma, Chairman, Committee on Hydraulic Structures

2:30 Operation of Spillways in Northwest Projects

R. B. Cochrane, M. ASCE, Portland Dist., Corps of Engineers, Portland, Oreg.

3:00 Spillway Performance at Corps of Engineers Projects in California

William C. Cassidy, South Pacific Div., Corps of Engineers, San Francisco, Calif.

3:30 Operation of Spillways and Sluices for Tennessee Valley Dams

Kenneth W. Kirkpatrick, A. M. ASCE, Hydraulic Engr., Tenn. Valley Authority, Norris, Tenn.

CABARET NIGHT FOR MEMBERS AND WIVES

Thursday, Oct. 16

8:00 p.m. Ballroom

A gala evening for informal sociability, excellent entertainment, and a chance to chat with friends and business associates.

Per person $3.75

MIT DINNER

The MIT Club will hold its dinner at the Hotel Biltmore at 6:00 p.m., Thurs., Oct. 16, preceding the Convention Cabaret. The Club Bar will be available from 5:00 p.m. Don't miss Dr. Wilbur's annual report.

UNIV. OF ILLINOIS DINNER

The civil engineering alumni of the University of Illinois, with their wives and friends attending the Convention, will meet for their 32nd annual informal dinner on Thursday evening, October 16, at 6:00 p.m. For further details as to final arrangements, please phone Harold T. Larsen, PE-6-9220. Ladies and other guests are invited. Dinner will be over in time to permit attendance at the evening events of the Convention.

FRIDAY MORNING

OCT. 17

Construction, Eng. Mech., Structural Divs., Joint Session with IABSE

9:00 a.m. Ballroom

Steel Bridges and Building Frames

Presiding: Walter L. Couse, Chairman, Exec. Committee, Construction Div.

9:00 The Design, Construction and Performance of Short, Flexible Suspension Bridges for Heavy Trucks

Sven O. Asplund, M. ASCE and IABSE, Prof., Structural Mechanics, Chalmers Univ., Gothenburg, Sweden.

9:35 Structural Steel Design as Affected by Fabrication and Erection Requirements

E. Leland Durkee, M. ASCE, Engr. of Erection, Fabricated Steel Construction, Bethlehem Steel Co., Bethlehem, Pa.

10:10 Steel Buildings and Fire Protection in Europe

C. F. Kollbrunner, M. IABSE, Managing Director, Conrad Zschokke, Ltd., Doettingen and Zurich, Switzerland.

10:40 Trends in Development in Steel Structures in America

Thomas C. Kavanagh, M. ASCE and IABSE, Partner, Praeger-Kavanagh Engrs., New York, N. Y.

11:10 Discussion

Eng. Mechanics Division

9:30 a.m. Gold Foyer

Physical Metallurgy and Mechanical Properties of Materials

Presiding: J. L. Waling, Chairman, Committee on Mechanical Properties of Materials

9:30 Ductility and Related Phenomena

J. M. Frankland, Consultant, Mechanics Div., National Bur. of Standards, Washington, D. C.

10:30 Open Discussion

10:50 Relaxation Theory of Creep and Flow

H. Eyring, Dean, Graduate School, and A. T. Ree, Prof. of Chemistry, Univ. of Utah, Salt Lake City, Utah.

11:40 Open discussion

Power Division

9:00 a.m. West Room

***Presiding:** M. P. Aillery, Chairman, Program Committee for Symposium on Thermal Power Plants*

9:00 **Design and Selection of Hyperbolic Cooling Towers**
R. R. Rish and T. F. Steel, Specialist Engrs., Central Electricity Generating Board, England.

9:40 **Discussion**

American Cooling Towers
J. A. Scarola, J.M. ASCE, Civil Engr., Ebasco Services, Inc.

10:40 **Discussion**

10:50 **Hydraulics of Circulating Systems**
Clifton W. Bolieau, M. ASCE, Principal Mechanical Engr., TVA.

11:30 **Discussion**

11:45 **Statement regarding future activities**
M. G. Salzman, Member, Task Force on Thermal Power Plants, Committee on Progress in Power Plant Design.

Soil Mechanics and Foundations Division

9:30 a.m. Gold Room

Sponsored by Committee on Road and Airfield Soil Problems, Soil Mech. and Foundations Div., and Committee on Airport Pavement Design, Air Transport Div.

***Presiding:** Jorj O. Osterberg, Member, Exec. Committee, Soil Mech. and Foundations Div.*

9:30 **Special Pavement Requirements for Jet Aircraft Operation**
B. U. Duvall, Ohio River Div. Labs., Corps of Engineers, Cincinnati, Ohio.

10:00 **Pavement Design for Commercial Jet Aircraft**
P. F. Carlton, J.M. ASCE, Asst. Chief, Design and Analytical Branch, Ohio River Div., Corps of Engineers, Cincinnati Ohio; F. M. Mellinger, M. ASCE, Director, Ohio River Div. Labs., Corps of Engineers, Cincinnati; and R. G. Ahlvin, M. ASCE, Chief, Reports and Special Projects Section, Waterways Exp. Sta., Vicksburg, Miss.

10:30 **Use of Strains in Evaluation of Pavements by On-Site Heavy Rolling.**
Spencer J. Buchanan, M. ASCE, Prof. of Civil Eng., Texas A & M College, Bryan.

11:00 **Construction Materials Control, AASHO Road Test**
James F. Shook, A.M. ASCE, Acting Materials Engr., AASHO Road Test, National Academy of Sciences, Ottawa, Ill.

Sanitary Eng. Division

9:30 a.m. East Room

Water Treatment

***Presiding:** Ray E. Lawrence, Member, Exec. Committee, Sanitary Eng. Div.*

9:30 **Filter Plant Design**
Richard Hazen, M. ASCE, Partner, Hazen and Sawyer, New York, N. Y.

10:15 **Report of a Study to Develop More Effective Treatment of Lake Michigan Water**
Merrill B. Gamet, Prof., Civil Eng., Northwestern Univ., Evanston, Ill.; and J. M. Rademacher, Sanitary Engr., Regional Water Supply Consultant, USPHS, Park Forest, Ill.

11:00 **Pilot Plants for Water Treatment Research**
Gordon G. Robeck, in charge of Pilot Plant Studies, Water Supply Unit; and Richard L. Woodward, A.M. ASCE, Chief of Water Supply, Water Supply and Water Pollution Program, Taft Sanitary Eng. Center, Cincinnati, Ohio.

FRIDAY AFTERNOON

OCT. 17

Eng. Mechanics Division

2:00 p.m. Gold Foyer

Physical Metallurgy and Mechanical Properties of Materials

***Presiding:** J. F. Throop, Member, Committee on Mechanical Properties of Materials*

2:00 **Brittle Fracture**
B. L. Averbach, Assoc. Prof., Dept. of Metallurgy, Mass. Inst. of Technology, Cambridge.

2:50 **Open discussion**

3:00 **Fatigue of Structural Materials**
H. Grover, Chief, Applied Mechanics Div., Mechanical Eng. Dept., Battelle Memorial Inst., Columbus, Ohio.

3:50 **Open discussion**

4:00 **Review and Discussion of Physical Metallurgy and Mechanical Properties in Civil Engineering Practice**
Glenn Murphy, M. ASCE, Prof. and Head, Theoretical and Applied Mechanics, Iowa State College, Ames, Iowa.

Eng. Mech., Structural Divs., Joint Session with IABSE

1:30 p.m. Ballroom

Shell Structures

***Presiding:** Elmer K. Timby, Member, Exec. Committee, Structural Div.*

1:30 **Conception and Execution of the Shell Vault of the Palace of Exposition of the National Center of Industries and Techniques, Paris**
Nicolas Esquillan, M. IABSE, Technical Director, Boussiron Enterprises, Paris, France.

2:05 **Secondary Stresses in Shells**
Mario G. Salvadori, M. ASCE and IABSE, Prof., Civil Eng., Columbia Univ., New York; and Hans H. Bleich, M. ASCE and IABSE, Prof., Civil Eng. and Director, Guggenheim Inst. of Flight Structures, Columbia Univ., New York, N. Y.

2:35 **Design of Multiple Ribless Shells**
Anton Tedesko, M. ASCE and IABSE, Vice President, Roberts and Schaefer Co., New York, N. Y.

3:05 **Discussion**

Power Division

2:00 p.m. West Room

***Presiding:** M. G. Salzman, Member, Committee on Progress in Power Plant Design*

2:00 **Water Supply to Power Plants**
E. J. Stankiewicz, M. ASCE, Chief Structural Engr., Sargent & Lundy

2:40 **Discussion**

2:50 **Structural and Hydraulic Features of Intake and Discharge Structures**
H. K. Fairbanks, M. ASCE, Chief Civil Engr., Ebasco Services, Inc.

3:30 **Discussion**

3:40 **Ocean Cooling Water System for 800-kw Steam Power Station**
Robert H. Weight, A.M. ASCE, Supervising Civil and Structural Engr., Bechtel Corp.

4:20 **Discussion**

4:30 **Containment of Nuclear Plants**
R. N. Bergstrom, M. ASCE, Structural Engr., Sargent & Lundy

5:10 **Discussion**

Sanitary Eng. Division

2:30 p.m. **East Room**

Radioactive Wastes

Presiding: Lewis A. Young, Member, Exec. Committee, Sanitary Eng. Div.

2:30 **Treatment Plant for Removal of Radioactive Contaminants from Process Waste Water**

Engineering Design Features

Mark C. Culbreath, M. ASCE, Principal Engr., Burns and McDonnell Eng. Co., Kansas City, Mo.

3:15 **Evaluation of Performance**

Kenneth E. Cowser, Eng. Leader, and Roy J. Morton, M. ASCE, Association Section Leader, Waste Disposal Research and Eng. Sect., Health Physics Div., Oak Ridge Nat'l Lab., Oak Ridge, Tenn.

4:00 **Hydrological Aspects of Radioactive Waste Disposal**

William H. Bierschenk, J.M. ASCE, Geological Engr., Hanford Atomic Products Operation, General Electric Co., Richland, Wash.

Soil Mechanics and Foundations Division

2:00 p.m. **Gold Room**

Presiding: Stanley J. Johnson, Vice Chairman, Exec. Committee, Soil Mech. and Foundations Div.

2:00 **Foundations for a Major Power Station in Broken Limestone**

W. F. Swiger, M. ASCE, Consulting Engr., Stone & Webster Eng. Corp., Boston, Mass.; and H. M. Estes, Senior Structural Engr., Stone and Webster Eng. Corp., Boston, Mass.

2:40 **Engineering Geology in the Soil Conservation Service**

G. M. Brune, Aff. ASCE, Eng. Geologist, Eng. and Watershed Planning Unit, Soil Conservation Service, Forth Worth, Tex.

3:20 **Hydrologic and Structural Performance of Flood Prevention Work During 1957 Spring Floods in Arkansas, Oklahoma and Texas**

C. M. Moore, A.M. ASCE, Head, Design and Construction Sect., Eng. and Watershed Planning Unit, Soil Conservation Service, Fort Worth, Tex.

PRESS ROOM

Hudson Room

For the convenience of the technical press, newspapers and radio, a press room will be open throughout the days of the Convention.

WOMEN'S HOSPITALITY ROOM

Empire Suite **First Floor**

The Hospitality Room will be the gathering place of all ladies attending the Convention. It will be open from 2:00 to 5:00 p.m. on Sunday, Oct. 12, and 9:00 to 5:00 on each Convention day, Monday through Thursday. Hostesses will be in attendance to arrange tours and special events of interest, and to answer questions about facilities of the Convention and the City of New York.

WOMEN'S PROGRAM

An attractive variety of events has been scheduled for the entertainment of women attending the Convention. Breakfast and coffee hour are planned for each morning. A list of available trips with directions will be posted in the Women's Hospitality Room, where tickets for radio and television studios will also be available.

Monday, Oct. 13

At 10:00 a.m. the ladies will leave for the morning show at Radio City Music Hall. Luncheon will follow. Tickets at Music Hall.

Tuesday, Oct. 14

Buses will leave the hotel at 9:30 a.m. for Patricia Murphy's Candlelight Restaurant located in Yonkers. The ladies will tour the gardens at 10:30. Luncheon will be served in the Garden Room at 11:45, followed by a lecture on flower arrangements at 1:15. Chrysanthemum corsages will be provided for the ladies. Buses will leave Patricia Murphy's at 2:30 p.m. $5.00 per person. Limited to 106 women.

Wednesday, Oct. 15

A program of slides on "jewels" will be presented by the New York Telephone Co. at 3:00 p.m. No charge.

Thursday, Oct. 16

Breakfast will be served in the Charleston Garden Restaurant of B. Altman & Co. at 9:30 a.m. An interior decorator will speak on "Coordinating Accessories with What You Have." Two door prizes, gift certificates, will be presented. $2.00 per person.

A fashion show in the Terrace Room of the Plaza Hotel by one of New York's nationally known stores will follow the 12:45 luncheon at that hotel. $5.50 per person.

Separate detailed programs for the ladies will be available with a complete listing of all other Convention events of special interest to them.

SESSIONS OF THE BOARD

The ASCE Board of Direction will be in session, in the Headquarters Room, 18th floor, Hotel Statler-Hilton, at the following times:

Monday, Oct. 13, 9:00 a.m. to 5:00 p.m.

Tuesday, Oct. 14, 9:00 a.m. to 5:00 p.m.

Thursday, Oct. 16, 2:30 p.m.

INFORMATION AND REGISTRATION

Information and registration facilities will be maintained in the Rotunda on the Convention floor of the Hotel Statler-Hilton throughout the days of the Convention. Mail and messages will be held for members at the information desk.

ANNUAL CONVENTION COMMITTEE

Thomas J. Fratar, *General Chairman*
Gardner M. Reynolds, *Vice Chairman*
Barclay G. Johnson, *Past Chairman*
John P. Riley, *Board Contact*
B. Austin Barry, *Metropolitan Section Contact*
Don P. Reynolds, *Secretary*

Attendance Promotion

John Robinson, *Chairman;* Irvine P. Gould

Dinner-Dance

Carl A. Arenander, *Chairman;* Malcolm Pirnie, Jr., Austin E. Brant, Jr.

Exhibits

E. S. Kirkpatrick

Hotel Arrangements

Gardner M. Reynolds, *Chairman;* John F. Brennan

Kick-Off Party

Edward G. Wetzel, *Chairman;* Donald D. King, Irvine P. Gould

Luncheons

Michael N. Salgo, *Chairman;* Joseph S. Ward, Gordon Wallace

Public Relations

Joseph S. Ward, *Chairman;* John F. Brennan, Donald D. King

Student Activities

George A. Burpee, *Chairman;* Austin E. Brant

Thursday Evening Entertainment

Arthur J. Fox, Jr., *Chairman;* Malcolm Pirnie, Jr., Michael N. Salgo, Gordon Wallace

Women's Committee

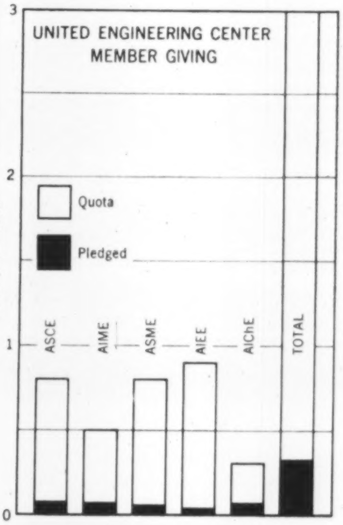
Mrs. Thomas J. Fratar, *Chairman*
Mrs. Gardner M. Reynolds, *Vice Chairman*
Mrs. Barclay G. Johnson, *Past Chairman*
Miss Irene R. Tomalis, *Secretary*

Mr. Carl A. Arenander, Mrs. Waldo G. Bowman, Mrs. Austin E. Brant, Jr., Mrs. John F. Brennan, Mrs. George A. Burpee, Mrs. E. Lawrence Chandler, Mrs. Arthur J. Fox, Jr., Mrs. Irvine P. Gould, Mrs. Clinton D. Hanover, Jr., Mrs. Donald D. King, Mrs. E. Stuart Kirkpatrick, Mrs. Enoch R. Needles, Mrs. Malcolm Pirnie, Jr., Mrs. Carlton S. Proctor, Mrs. Don P. Reynolds, Mrs. John P. Riley, Mrs. P. C. Rutledge, Mrs. Michael N. Salgo, Mrs. Charles E. Trout, Mrs. Gordon Wallace, Mrs. Joseph S. Ward, Mrs. Edward G. Wetzel, Mrs. William H. Wisely

SOCIETY NEWS

Member Giving for UEC Moves Forward

Status of Member Giving as of August 11



Local Sections have organized fund-raising groups to raise $800,000 by voluntary member subscription and a good start has been made. Ten percent of the $3 million member-giving quota has been pledged and ASCE is just a nose ahead of other Societies in dollars. Dr. Mervin J. Kelly's Industry Campaign has passed 70 percent of its goal.

Local Sections of the Founder Societies in Cincinnati have adopted an unconventional but effective way of conducting their drive for funds for the United Engineering Center in New York. They have joined forces under the guidance of a Sponsoring Committee comprised of leaders of our profession in that industrial community. Chairman Ernest S. Fields, president of the Cincinnati Gas & Electric Company, has with him as campaign chairman Kenneth H. Pettengill, AIChE; Cornelius Wandmacher, ASCE; Harry S. Progler, AIEE; and Lester L. Bosch, ASME. The combined effort of the committee is to canvass personally 1,500 individual members, and industrial groups in four geographical areas centering on Cincinnati.

Our Wisconsin Section is working with a "leap frog" plan for fund raising. Each member who contributes is obliged to get another to pledge a contribution; the second contributor must get another to pledge, and so on.

On August 11, the pledges and gifts totaled as shown in Table I and the accompanying bar chart.

Table I. Pledges to UEC as of August 11.

Society	Goal in Dollars	No. of Subscribers	Amount Pledged
ASCE	800,000	288	73,900
AIME	500,000	58	68,300
ASME	800,000	368	55,600
AIEE	900,000	338	39,700
AIChE	300,000	193	72,350
Others		37	18,250
Total	3,000,000	1,282	328,100
Industry	5,000,000	152	3,494,300
Grand Total	8,000,000	1,433	3,822,400

From ASCE Headquarters, the suggestion has gone out to Local Sections that their forthcoming news letters or bulletins give major emphasis to the campaign to raise funds for the United Engineering Center; or that special bulletins be prepared for the purpose.

Our profession has had a dynamic growth in numbers, service, and prestige. It is expected to double in size in the next quarter century. The new Center will include the facilities needed for that growth. It will contribute to unification of the profession.

Each engineer has entered the profession of his own volition; similarly, choosing to be a member of ASCE has been an individual matter. Each engineer has an obligation to do his part toward developing the profession and toward preserving America's engineering leadership. ASCE's modest quota of 8 percent of the total cost of the Center can readily be met, provided every member pledges his financial help and is willing to contribute his services to the campaign.

Cincinnati Sections of Founder Societies join forces in fund raising for United Engineering Center. Left to right, they are: Kenneth H. Pettengill, AIChE; Cornelius Wandmacher, ASCE; Ernest S. Fields, AIEE, Chairman; Harry S. Pragler, AIEE; and Lester L. Bosch, ASME.

ICA to Obtain Engineering Services by Negotiation

The International Cooperation Administration (ICA) is the last large U. S. Government agency to adopt the method of obtaining the professional services of engineers and architects by negotiation instead of on the basis of lowest bid. For nearly two years ASCE has been working with the ICA in the hope of convincing it that the recommended ASCE procedure of engaging engineering services by negotiation on the basis of ability to perform services required is in its best interest.

This change in ICA procedure, issued as ICA Policy Directive No. 12 on August 1, is hailed as an important event. It occurred after much correspondence and several conferences between, on the one hand, Secretary Wisely, his staff, and ASCE's Washington representatives (the legal firm of Covington and Burling) and on the other hand, ICA Deputy Director for Technical Services Edwin H. Arnold and his staff.

As a part of the new procedure, the Office of Industrial Resources, which is under the Office of the Deputy Director for Technical Services, is taking steps to update the information on engineering and architectural firms listed in the Office's Uniterm Index. The Office of Industrial Resources has advised the secretaries of the various engineering and architectural societies that in the future firms listed in the Index will be considered as interested in contracts with ICA. Interested firms whose qualifications are not on file, or whose filed qualifications are out of date, are urged to submit the necessary data to the Office of Industrial Resources of ICA, Washington 25, D. C. It is ICA policy to issue contracts to as many qualified firms as are needed to conduct its world-wide engineering and architectural work effectively and promptly.

After considering all firms listed in the Index, the Office of Industrial Resources will list in order of preference at least three firms judged to be best qualified for the project under consideration. The principal factors being considered in making the selection are:

1. Reputation and standing of the firm and its principal members for performance of the contemplated type of work.
2. Specialized experience in the field of activity for which the services are required.
3. Past record in performing work for ICA, other government agencies, and for private industry, including performance from the standpoint of cost, quality of work, and ability to meet schedules.
4. The volume of work of the firm with ICA in previous years and the extent to which the firm is currently engaged in other work.
5. Ability to assign an adequate number of qualified personnel from the firm's own organization, including a competent supervising representative having considerable experience in responsible positions on work of a similar nature.
6. The portion of the work the firm is able to perform with its own forces when required.
7. Ability of the firm to furnish or to obtain required materials and equipment.
8. Financial resources.
9. Familiarity with the locality in which the project is located.

A panel, consisting of the Director of Contract Relations, who is the chairman, the Director of the Office of Industrial Resources, and the Deputy Regional Director for the geographic area in which the project is located, will consider the recommendations and information submitted to it and agree upon and establish a list of firms in order of preference. In case of disagreement, the Deputy Director of Technical Services will make the final decision.

Next the Director of Contract Relations will negotiate with the first firm on the list received from the panel to obtain a satisfactory contract. At this negotiation, the firm will make known its estimate of cost for performing the service and the fee. If agreement is not reached, the firm will be notified of the termination of negotiation, and negotiation will be started with the next firm on the list. This procedure will continue until an agreement is reached.

An engineering or architectural firm which has a contract with ICA will normally be barred from consideration by ICA for a contract to construct the same project unless an exception is approved by the Director.

This new ICA policy is to be incorporated in appropriate ICA Manual Orders at an early date.

Awards to Engineers

Raymond A. Wheeler (Lt. General, USA, ret.) engineering consultant to the International Bank for Reconstruction and Development, Washington, D. C., is the nineteenth recipient of the Hoover Medal "awarded by engineers to a fellow engineer for distinguished public service." The presentation will be made at appropriate ceremonies this fall.

Mervin J. Kelly, president of Bell Laboratories, has been awarded the John Fritz Medal for his achievements in electronics and leadership in a great industrial research laboratory.

The Hoover and Fritz Medal winners are each selected by a joint committee from several engineering societies.

Alexander B. Rudavsky, A.M. ASCE, has been given the Freeman Award with a $3,000 grant. Mr. Rudavsky is a design engineer with Justin and Courtney, now in Tehran, Iran. He plans to study energy dissipation below dams, and his multilingual ability will permit him to include both European and American practice in his analysis. The Freeman Award is a joint award of ASCE and the American Society of Mechanical Engineers.

William W. Troutman, graduate student at the Massachusetts Institute of Technology, has been named winner of the J. Waldo Smith Hydraulic Fellowship. The fellowship will cover the academic year 1958-1959, and will provide $1,500, plus $500 for equipment, for Mr. Troutman's research project which deals with an investigation of the effect of turbulence on suspended particles in circular pipes as related to the transportation of wood pulp in paper-making processes, dredging, silt transport, and the flow of drill-mud.

Competition for Mead Prize Opens

"The Responsibilities of the Employee Engineer to His Employer" is the subject selected by the Board of Direction for the 1959 Daniel W. Mead Prize Competition. Both Junior Members and students will write on the same topic this year. The Junior Member award consists of a cash prize of $100 and an engraved certificate, while the student prize carries a cash award of $50 and an engraved certificate.

To be eligible, papers must not exceed 2,000 words, and they must be presented before a Local Section or Student Chapter meeting. Only the one best paper from each Section and Chapter can be entered in the final competition. All entries must reach the office of the Executive Secretary at Society headquarters by May 1, 1959.

Returns from 1958 Employment Questionnaire Summarized

Report of ASCE Committee on Employment Conditions: Charles W. Griffin, Jr., *Chairman*, R. Earl Salveter, *Vice Chairman*, Jack Y. Long, Irving F. Ashworth, and Donald H. Mattern, *Board Contact Member*

In order to determine the trends in employment conditions and member attitudes concerning certain phases of the subject since the Society's survey in 1953, a second Employment Conditions Survey was conducted this year. The questionnaire was sent to all members of the Society resident in the continental United States, Alaska, Hawaii, Puerto Rico and the Canal Zone. On this basis, 37,193 questionnaires were mailed. A total of 21,036 were received and turned over to the Service Bureau Corporation for tabulation and analysis. About 200 more returns were received subsequently but were not included in the tabulation.

The 21,036 replies represent a return of about 57 percent, which is considered excellent for such surveys and is about 4 percent better than the response in 1953. A study of the returns by member grade indicates that the distribution of the returns closely parallels that of the Society membership. The results therefore can safely be projected as representative of the attitudes and thinking of the entire membership.

Following are the results as tabulated by the Service Bureau Corporation. No attempt has been made to interpret them. They are available to the Committee on Employment Conditions of the Board of Direction and such other Society committees as may find them useful to their activity.

Question 1. Check your grade in ASCE:

ASCE Grade	No. of Returns	%	Distribution of Entire Membership %
Junior Members	7,949	37.8	41.9
Associate Members ..	7,330	34.9	33.6
Members	5,603	26.6	24.2
Affiliates	34	0.2	0.2
	20,916		Hon.
Unclassified	120	0.5	M. 0.1
Total	21,036	100.0	100.0

Question 2. Check your age bracket:

Age	No. of Returns	% of Returns
20-30	5,383	25.6
31-40	6,398	30.4
41-50	3,448	16.6
51-60	3,186	15.2
61-70	1,672	7.9
71, over	826	3.9
Rejected	87	0.4
Total	21,036	100.0

Question 3. Check your employment status:

	No. of Returns	% of Returns
Employer	4,159	19.8
Supervisor	8,334	39.6
Employee	7,848	37.4
Other	18	3.2
Rejected	677	....
Total	21,036	100.0

Question 4. In what state do you reside? (For answers see "Total" column, Question 10.)

Question 5. Are you a registered Professional Engineer? Are you a registered Engineer-in-Training? Neither?

	No. of Returns	% of Returns
Professional Engineer	13,611	64.7
Engineer-in-Training	3,050	14.5
Neither	4,225	20.1
No answer	150	0.7
Total	21,036	100.0

	Prof. Engr.	Engr. in Tr.	Neither	No Answer
Junior Members ..	2,825	2,790	2,280	54
Associate Members .	5,680	228	1,377	45
Members	5,016	23	526	38
Affiliates	9	1	24	—
Unclassified	81	8	18	13
Totals	13,611	3,050	4,255	150

Question 6a. Is your principal employment:

	No.	%
Gov't service .... (Fed., State, City)	7,065	33.6
Private eng. practice	5,811	27.6
Industry (Incl. Constr.) ..	6,631	31.6
Education	1,151	5.5
No answer	378	1.7
Total	21,036	100.0

Question 6 b Check one phase of civil engineering that is closest to your work:

City Planning	502	Structures	5,391
Surveying	704	Soils	699
Transportation ...	3,052	Construction	4,802
Drainage	3,329	Education & Research	893
Sanitary	1,135	No answer	527

Question 7. If a supervisor or an employee, give your job classification under the ASCE grades:

I	410	VII	1,994
II	1,372	VIII	1,553
III	2,481	IX	737
IV	2,585	No answer ...	440
V	2,480	Total	16,182
VI	2,130		

(Remainder between 16,182 and 21,036 could not be tabulated on cards.)

Answers to Question 5 by area of employment (refer to 6*a*):

	P.E.	Percent	E.I.T.	Percent	Neither	Total Percent P.E. & E.I.T.	
Government	4,423	(62.7)	1,034	(14.6)	1,565	(22.1)	77.5
Private practice	4,434	(76.3)	723	(12.4)	634	(10.9)	88.7
Industry	3,758	(56.7)	1,121	(17.0)	1,720	(25.0)	73.7
Teaching	788	(68.3)	143	(12.4)	215	(18.6)	80.7
No answer	208		29		91		
Totals	13,611		3,050		4,225		

Percentages do not quite total 100 across because of the number of "No Answer" to Question 6(*a*).

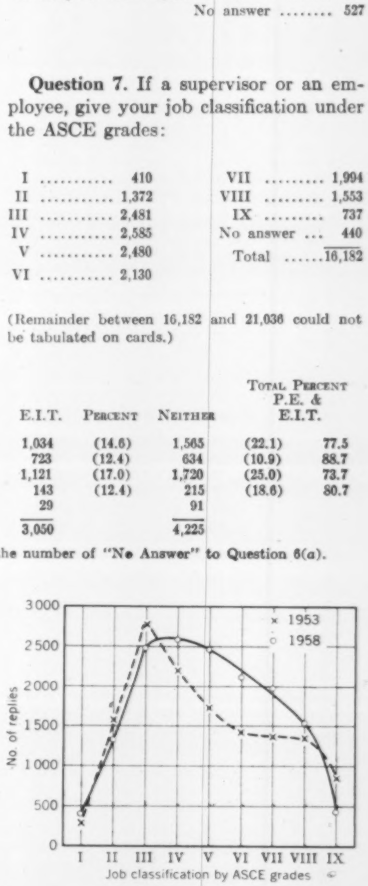


FIG. 1. Distribution of replies to Question 7 by grade of employment

Question 8. With respect to membership in a collective bargaining unit:

(*a*) Would you join voluntarily?

(*b*) Would you join if necessary to hold present job?

AGE	JOIN VOLUNTARILY		TO HOLD JOB		NO
BRACKET	YES	NO	YES	NO	ANS.
20-30	882	4,304	1,815	3,074	88
31-40	955	5,197	2,165	3,486	118
41-50	398	2,916	1,278	1,676	100
51-60	309	2,714	1,141	1,483	108
61-70	138	1,397	346	986	90
71 over	39	653	97	454	119
Rejected	7	62	24	37	16
Totals	2,728	17,243	6,866	11,196	639

Question 9. Do you consider that collective bargaining is, or would be, advantageous to you?

Collective Bargaining Advantageous

	YES	NO	NO ANSWER
Jun. M.	1,654	6,088	207
Assoc. M.	1,217	5,787	326
Members	559	4,690	354
Affiliates	4	30	
Unclassified	13	86	21
Totals	3,447 (16.4%)	16,681 (79.3%)	908 (4.3%)

In 1953 this question was worded somewhat differently, to read, "Are you opposed to collective bargaining?" The answers were:

	YES	NO
Junior Members	3,945	3,080
Assoc. Members	3,415	1,871
Members	3,328	1,234
Affiliates	6	10
	10,694 (63%)	6,195 (37%)

Question 9a. If your answer above is "Yes," would you prefer to be represented by:

AGE BRACKET	(*a*) PROF. EMPLOYEE BARGAINING GROUP	(*b*) LABOR OR CRAFT UNION	NO ANSWER
20-30	1,052	23	30
31-40	1,158	31	55
41-50	484	24	12
51-60	339	17	15
61-70	153	12	10
71 over	45	1	5
Rejected	11	..	..
Totals	3,242	108	97

Question 9b. Why would it be advantageous to you?

	ECONOMIC BENEFITS?			WORKING CONDITIONS?		
AGE BRACKET	YES	NO	NO ANSWER	YES	NO	NO ANSWER
20-30	1,036	33	36	551	360	194
31-40	1,156	20	38	570	379	265
41-50	501	3	16	235	134	151
51-60	342	3	26	143	74	154
61-70	151	4	20	65	25	85
71 over	44	1	6	15	4	32
Rejected	11	..	..	6	2	3
Totals	3,241	64	142	1,585	978	884

Question 10. Are you a member of an established collective bargaining group, whether or not certified by NLRB and/or a "labor union"?

AGE BRACKET	YES	%	NO	%	NO ANSWER	%
20-30	129	(2.4)	5,226	(97.2)	28	(0.4)
31-40	169	(2.6)	6,184	(96.7)	45	(0.7)
41-50	70	(2.0)	3,369	(96.7)	45	(1.3)
51-60	74	(2.4)	3,058	(95.8)	54	(1.6)
61-70	33	(2.0)	1,586	(94.8)	53	(3.2)
71, over	12	(1.5)	751	(91.0)	63	(7.5)
Rejected	1		78		8	
Totals	488	(2.3)	20,252	(96.3)	296	(1.4)

In the 1953 questionnaire, answers to Question 10 listed members of established collective bargaining units as follows:

AGE BRACKET	NUMBER	%*
20-30	256	4.7
31-40	140	3.6
41-50	98	3.2
51-60	73	3.2
61-70	46	2.4
71, over	11	1.9

* Percentage of returns in that age category.

Membership in collective bargaining groups, by states:

STATE	TOTAL	YES, BELONG TO A UNION	
		1953	1958
Alabama	272	3	2
Alaska	61	3	0
Arizona	151	3	3
Arkansas	96	4	1
California	3,376	222	168
Canal Zone	2	0	0
Colorado	421	7	5
Connecticut	256	11	8
Delaware	102	0	0
Dist. of Col.	249	11	6
Florida	479	0	2
Georgia	291	8	3
Hawaii	152	9	6
Idaho	94	4	1
Illinois	1,109	21	13
Indiana	295	15	13
Iowa	193	4	2
Kansas	348	2	3
Kentucky	202	6	2
Louisiana	359	0	1
Maine	104	5	1
Maryland	681	8	5
Mass.	618	8	12
Michigan	529	9	8
Minnesota	255	4	4
Miss.	154	4	1
Missouri	558	3	5
Montana	85	5	2
Nebraska	186	1	1
Nevada	51	3	0
New Hamp.	59	0	1
New Jersey	707	6	7
New Mexico	120	2	0
New York	1,853	49	56
North Car.	197	4	4
North Dak.	42	1	0
Ohio	848	8	8
Oklahoma	172	4	1
Oregon	290	15	11
Penn.	1,162	12	7
Puerto Rico	58	0	0
Rhode Is.	66	2	1
South Dak.	39	0	1
South Car.	131	1	0
Tennessee	372	51	38
Texas	1,067	8	5
Utah	136	3	0
Vermont	28	0	0
Virginia	597	3	10
Wash.	624	62	40
West Va.	117	1	1
Wisconsin	333	6	14
Wyoming	58	0	1
No indication	230	4	0
Total	20,806		

Question 11. Those responding "Yes" to Question 10 indicated membership in collective bargaining units as follows:

(*a*)	Professional unions	144
(*b*)	Trade unions	145
(*c*)	National Federation of Federal Employees	51
(*d*)	State, county, and municipal employees' organizations	148
	Total	488

The figure 488 includes all who answered "Yes" to the question, "Are you a member of a collective bargaining group. . . ." However, many included in category (*d*) are not collective bargaining units in the sense intended in the questionnaire, as they do not have the right to strike. They largely operate as legislative lobbies seeking improved pay and working conditions through contact with state legislatures. The NFFE likewise is not a collective bargaining unit in the statutory sense.

A number of the respondents listed in the "trade union" category were employees, holding membership in one of several trade unions such as iron workers, plasterers, etc.

Question 12. Do you receive in conjunction with your employment:

	YES	NO
(*a*) Health benefits	11,307	6,976
(*b*) Life insurance	11,585	6,527
(*c*) Pension program	12,463	5,900
(*d*) Profit sharing or bonus	6,783	10,422
Total receiving some benefit	18,000	
Total not receiving some benefit	2,074	
No answer	962	
	21,036	

Sections Urged to Enter Howard Award Candidates

Awarded annually to a member of ASCE who has made a definite contribution to the advancement of structural engineering, the Ernest E. Howard Award is given in honor of the late Ernest E. Howard, Past President of ASCE.

Local Sections are urged to enter candidates for this award. Nominations should include a photograph or narrative description of a single engineering achievement. Information concerning the achievement of the Local Sections' candidates should be sent to the Executive Secretary, of ASCE, prior to February 1, 1959. These entries will be forwarded to the Ernest E. Howard Award Committee, which will report its recommendation to the Board of Direction prior to May 1, 1959.

ASCE Executive Committee Meets in Milwaukee

President Louis R. Howson presided over a meeting of the Board's Executive Committee held on August 1 at the Plankinton Hotel in Milwaukee. Among the actions taken was one to approve a draft of proposed amendments to the Constitution which would implement changes in the classification of members. Vice-Presidents were requested to obtain the required petitions from the four Zones before August 31. A resumé of the proposed changes is printed on page 33 of this issue. A more detailed explanatory statement by Chairman Frank L. Weaver, of the Task Committee on Classification of Members, was recommended for approval by the Board of Direction for publication in CIVIL ENGINEERING after the Annual Convention.

Student Chapters

An official request of the National Society of Professional Engineers was approved for permission to distribute certain NSPE literature to Faculty Advisors of ASCE Student Chapters.

The Executive Secretary was requested to initiate a Student Chapter Newsletter, with the sanction and guidance of the ASCE Committee on Student Chapters, as a means of continuously transmitting information to Student Chapters about ASCE activities.

Fund Raising for UEC

After the Executive Secretary presented a detailed summary of the United Engineering Center fund-raising activities of ASCE, the Executive Committee directed the Secretary to adjust the Local Section quotas by apportioning the Society's goal of $800,000 in accordance with the membership assigned to each Local Section. The quotas computed from the membership figures shown on page 116 of the 1958 Official Register have been sent to Local Section officers for their information and guidance. As an example, 1,447 members of the 40,130 total assigned membership are assigned to the Illinois Section. The Section's proportion of $800,000 is $29,000.

Appointments

President Howson was authorized to revise the schedule of appointments to represent ASCE on Engineers Council for Professional Development.

Past President Mason G. Lockwood was named as a member of ASCE's Task Committee on Administrative Procedure.

Milwaukee Host to District 7 and Four Committees

Technical sessions, Society prizes, and discussions on the profession were some of the highlights of the successful District 7 Conference. The Wisconsin Section was host to 160 visiting members and their wives for the two-day program, August 1 and 2.

At the first session, a report on European prestressed concrete practices was brought to the members when Karl Roesser, A.M.ASCE, of the Portland Cement Association spoke on "Present and Future Developments in Prestressing." Mr. Roesser attended the 1958 World Prestress Conference which was held in Berlin on May 10. At this session also, W. J. Schmidt, chief of Public Information for the National Test Road Project of AASHO, summarized progress and results to date on the project, in a talk entitled, "Large-Scale Highway Research."

After the morning meeting, those attending the conference viewed a number of interesting engineering exhibits. At the luncheon meeting, President Howson addressed the group on "What's Ahead for the Civil Engineer." He presented the 1957 J. C. Stevens Award to Neal E. Minshall, A.M.ASCE, research project supervisor of the Soil Conservation Service of the U. S. Department of Agriculture.

In the afternoon, members learned of recent waterway developments from H. C. Brockel, Municipal Port Director for the City of Milwaukee. His talk was concerned especially with waterway development on the Great Lakes. Taking to the air, Roger Sekadlo, manager of Milwaukee's County Airport, discussed "Future Requirements in Airport Design."

For an excellent example of urban development, members enjoyed an afternoon tour of the new $25 million Mayfair Shopping Center, the largest shopping center in Wisconsin.

The importance of the electronic computer to today's engineer was the topic for the third session, on the morning of August 1. Duane Wentworth, research engineer with International Business Machines Corp., spoke on "Present and Future Developments in Electronic Computers." To follow up the subject as it specifically applies to engineering, Elmer Timby, M.ASCE, of Howard, Needles, Tammen and Bergendoff, discussed, "Applications of Electronic Computers for Civil Engineers."

At the noon luncheon, Adolph Ackerman, M.ASCE, consultant of Madison, Wis., spoke on the all-important problem of "Engineering Education." Mr. Ackerman was chairman of the ASCE Task Committee on Professional Education.

In addition to the technical features, the Wisconsin Section provided a full program for the ladies and offered several entertaining social activities for the whole group.

Beside the District 7 Conference, the Executive Committee of ASCE, the Committee on Conditions of Practice, the Salary Committee, and the Employment Conditions Committee met in Milwaukee at the same time. The employment report is included in this issue.

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At luncheon meeting of District 7 Conference, President Howson presents 1957 J. C. Stevens Award to Neal E. Minshall (photo at left). Wisconsin Section president W. G. Murphy (center, photo at right) introduces speakers at first technical session; on his left is Karl Roesser, and on his right W. J. Schmidt.

International Structural Program at ASCE Convention

The field of structural engineering has probably changed more rapidly in the years since World War II than at any other time in its history. Entirely new concepts of design have emerged to challenge the structural engineer as never before. With this challenge has come the opportunity to effect great advances in the economy, utility and beauty of many types of structures. To the engineer who is alert to opportunity, the joint ASCE-International Association of Bridge and Structural Engineering meeting at the New York Convention affords a unique chance to hear authoritative appraisals of current trends and research.

An unusually large attendance is expected for this meeting. In order to make satisfactory arrangements, advance information on attendance is essential. All members planning to attend are urged to fill out and return the coupon on page 119, and to make hotel reservations.

Biographies and subjects of 14 European speakers were printed in the August issue. Information on the American speakers is given here.

Lynn S. Beedle, research professor and chairman of the Structural Metals Division at Fritz Engineering Laboratory, Lehigh University, received the degree of bachelor of science in civil engineering from the University of California in 1941, and the degree of doctor of philosophy from Lehigh University in 1952. After a short period with the Todd-California Shipbuilding Corporation, he served in the Navy from 1941 to 1947 as a teacher in the postgraduate school at the U. S. Naval Academy and as Officer-in Charge of Underwater Explosions Research at the Norfolk Naval Shipyard. He joined the Fritz Laboratory at Lehigh in 1947.

Professor Beedle's paper is on "Ductility as a Basis for Steel Design." After a brief review of large-scale tests conducted in the United States, the role of ductility in the inelastic behavior of structural members and the development of plastic design procedures is presented. Ways of speeding up the design process, new procedures for proportioning connections for industrial building and multistory frames are also explained. Finally, it will be shown how problems of structural stability can be solved through a knowledge of the stress-strain characteristics beyond the elastic limit.

Hans H. Bleich, professor of civil engineering and director of the Guggenheim Institute of Flight Structures, Columbia University, received the degree of civil engineer from the Technical University of Vienna, Austria, in 1933, and the degree of doctor of engineering science from the same institution in 1934. From 1933 to 1944, he designed bridges and heavy industrial buildings in Austria and Great Britain. In 1945, he came to the United States as an associate engineer with Hardesty and Hanover, consulting engineers of New York. He joined the faculty at Columbia in 1950.

Mario G. Salvadori, professor of civil engineering, Columbia University, received the degree of doctor of civil engineering in 1930 and doctor in pure mathematics in 1932, both from the University of Rome, Italy. He was a student of photoelasticity under Professor Coker at University College, London, in 1933 and 1934, then returned to the University of Rome where he was an instructor in Theory of Structures in the School of Engineering and in the School of Architecture until 1938. He went to Columbia University in 1941. He is a lecturer with the rank of professor of architecture, Princeton University. In addition to his academic duties, he is currently an associate of Paul Weidlinger Consulting Engineers, New York City.

Hans H. Bleich and Mario G. Salvadori collaborated on the paper "Secondary Stresses in Shells." The penetration of bending moments arising at the boundary of thin shells is studied for the case of shallow hyperbolic paraboloids supported along rectilinear generatrices, under the assumption of elastic behavior. Results are extended to boundary disturbances in other types of shells with curvature of opposite sign and are related to the spreading of boundary disturbances in shells with curvatures of equal sign (rotational shells, cylinders, etc.).

Daniel C. Drucker, professor of engineering and chairman, Division of Engineering, Brown University, received a B.S. in 1937 and a Ph.D. in engineering in 1940, both from Columbia. He was an engineering assistant for the New York Tunnel Authority in 1937, and in 1940 became an instructor at Cornell. After a period as supervisor of mechanics of solids at Armour Research Foundation, he became a member of the faculty at Brown in 1946 and chairman of the Division of Engineering in 1953.

Dr. Drucker presents "Some Recent Developments in Plastic Analysis and Design." The problems of minimum weight design, of effects of change in geometry including membrane strengthening and plastic buckling, of work-hardening, creep and dynamic loading are treated. Recent developments are described and probable paths of future investigation will be outlined.

Lynn Beedle

Hans Bleich

M. Salvadori

E. L. Durkee

D. C. Drucker

E. Hognestad

E. L. Durkee, engineer of erection, fabricated steel construction, Bethlehem Steel Company, graduated from Worcester Polytechnic Institute in 1919 and was awarded a C.E. in 1924. He was with the McClintic-Marshall Company from 1919 to 1931, and has since been with the Bethlehem Steel Company on design and erection of bridges and other steel structures. He was engineer of erection or resident engineer on: the Outerbridge Crossing, the Cooper River Bridge in Charleston, S. C.; the Mississippi River Bridge at Baton Rouge, La.; the Rainbow Bridge at Niagara Falls, N. Y.; and the Pecos River Bridge in Texas. Many of these structures set records for span or embodied new concepts of design and erection. Recently he was in charge of planning erection methods and design of erection equipment for the Chesapeake Bay Bridge.

Mr. Durkee, in his paper, "Structural Steel Design as Affected by Fabrication and Erection Requirements," discusses problems in erection of steel bridges arising from recent trends in modern bridge design. Methods of erection, equipment, falsework and other temporary erection devices are presented. The various details of design which make for economi-

G. W. Housner

T. Kavanagh

T. Y. Lin

N. Newmark

A. L. Parme

A. Tedesko

cal fabrication and erection are discussed, and an example of actual bridge erection, from cost estimate to completion, is given.

Eivind Hognestad, manager, Structural Development Section, Portland Cement Association, is a graduate engineer from Norway's Institute of Technology. He has a master of science degree from the University of Illinois, and the degree of doctor of the technical sciences from Norway Institute of Technology. He was a research associate professor of theoretical and applied mechanics at the University of Illinois before joining the Portland Cement Association in 1953. He has worked primarily in experimental research and development in the field of structural concrete.

Mr. Hognestad's paper, entitled "Effects of Research on Modern American Structural Concrete Design," examines the methods, accomplishments and aims of research and development in structural concrete during the past decade with respect to structural design. Ultimate strength design is outlined, including research findings regarding shearing strength and effects of column slenderness. The present status of limit design and American contributions to prestressed and precast concrete technology are presented. The development of the A-305 deformed bar is examined, including recent research on high-strength steel bars.

George W. Housner, professor of engineering, California Institute of Technology, graduated in civil engineering from the University of Michigan in 1933, and received a Ph.D. degree from the California Institute of Technology in 1941. He was a practicing structural engineer from 1934 to 1939, joined the U. S. Army Corps of Engineers in 1941, and was chief of the Operations Analysis Section, 15th Air Force, from 1943 to 1945. He assumed his present position in 1945.

Professor Housner will speak on "The Behavior of Structures During Earthquakes." Accelerograms of strong earthquakes have well-defined characteristics and may be treated as stationary time processes. Computations of general vibrational features of structures subjected to such excitations are in agreement with measurements of building oscillations during earthquakes. Accelerations of buildings are larger than would be consistent with the customary design lateral forces, and the stresses can be expected to exceed the elastic limits. Hence a limit design analysis is required to evaluate the adequacy of current design rules. It is found that inelastic behavior is effective in mitigating structural oscillations.

Thomas C. Kavanagh, partner, Praeger-Kavanagh Engineers, New York City, received bachelor's and master's degrees in civil engineering from the City College of New York, and a master's degree in accounting and finance and the degree of doctor of science in engineering from New York University. He has been a structural designer on many projects, including power plants, waterfront and industrial structures. He was senior design engineer for Modjeski and Masters on the review of bridge designs of all consultants on the Pennsylvania Turnpike. With Gannett, Fleming, Corddry and Carpenter, Inc., he was consultant on design of bridges for the New Jersey Turnpike, the Allentown Expressway and the Philadelphia Expressway. He became professor of civil engineering at Pennsylvania State University in 1948, and was professor and chairman of the Department of Civil Engineering at New York University from 1952 to 1954.

Mr. Kavanagh will speak on "Trends and Developments in Steel Structures in America." An outline is presented of the principal paths of structural steel research and development in the United States in the past decade leading toward improvement of materials, new principles of steel design, connections, structural elements and structural assemblages. Trends of application of these principles in practice are discussed. Outstanding examples are given to show landmarks and trends in the fields of bridge engineering, tall building construction, towers, stadiums and exhibition buildings, maritime, military and large-scale scientific structures.

T. Y. Lin, professor of civil engineering and research engineer, Institute of Transportation and Traffic Engineering, University of California, Berkeley, received a B.S. degree in civil engineering from Chicotung University, China, in 1931, and a M.S. degree in civil engineering from the University of California in 1933. From 1933 to 1946, he was successively engineer and chief design engineer, Chinese Government Railway. He has been on the faculty of the University of California and in consulting practice since 1946, specializing in prestressed concrete. He is author of "Design of Prestressed Concrete Structures," 1955.

Professor Lin brings to the meeting information on "Research and Design of Prestressed Concrete Slabs and Shells in the United States." Experimental investigations of the behavior and strength of prestressed concrete flat slabs, both in flexure and in shear, and of a hyperbolic-paraboloid prestressed concrete shell, are described. Examples are given showing recent designs of various types of prestressed concrete lift slabs and thin shells in the United States. Analytical methods for design are briefly discussed.

Nathan M. Newmark, professor and head of the Department of Civil Engineering, University of Illinois, received a B.S. degree from Rutgers University in 1930, and M.S. and Ph.D. degrees from the University of Illinois in 1932 and 1934. A member of the staff of the University of Illinois since 1930, he was in charge of the Structural Research Laboratory from 1946 to 1957, and is chairman of the Digital Computer Laboratory. During World War II, he was a consultant to the National Defense Research Committee and the Office of Scientific Research and Developments, and was awarded the President's Certificate of Merit in 1948. From 1945 to 1949, he was a member of the Scientific Advisory Board of the U. S. Air Force, and since 1947 has been a member of a committee of the Board. He has served as a consultant to many industrial organizations and governmental agencies, and has been associated with nearly all atomic tests dealing with effects on structures. He was consultant on the aseismic design of the 43-story Latino-Americana Tower in Mexico City.

Professor Newmark will present a most timely discussion on "Use of High-Speed Computer in Structural Dynamics: Shock, Vibration, Earthquake and Blast." General techniques for the solution of dynamics problems are described with particular application to the use of

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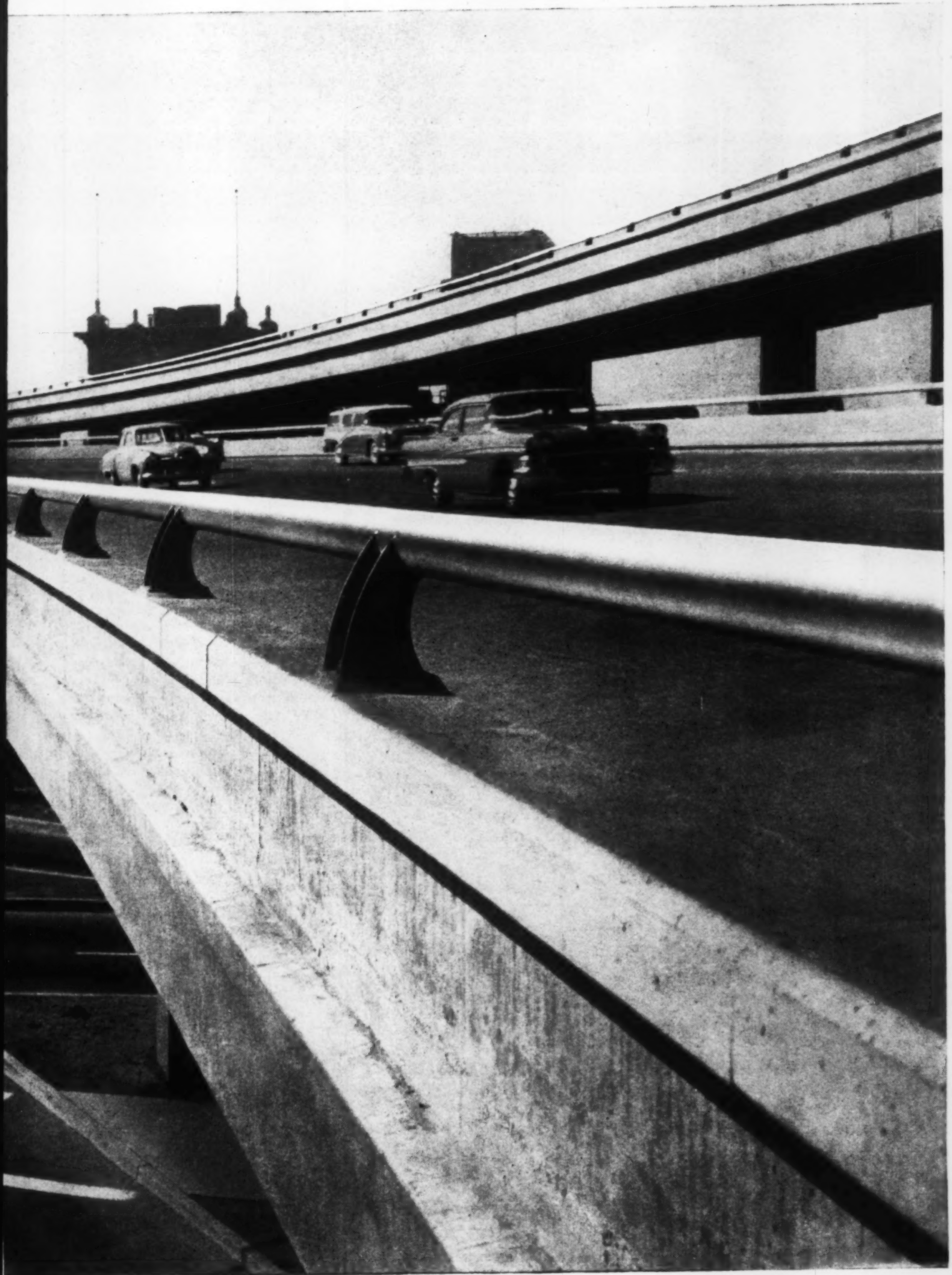


B. Thurlimann

G. S. Vincent

C. S. Whitney

a high-speed digital computer. Consideration is given to nonlinear behavior and to variation in loading with time. The transient effects of dynamic disturbances are considered, as well as the responses of structures and structural elements subject to a series of systematic or random input motions or forces.

Alfred L. Parme, manager, Structural and Railways Bureau, Portland Cement Association, Chicago, received a B.S. degree in civil engineering from Cornell University in 1935. He was employed by Ebasco Services, Inc., from 1936 to 1937, and by the U. S. Engineers from 1937 to 1940, where he was responsible for design of hydraulic structures on flood-control projects. He joined the Portland Cement Association in 1940 as a structural engineer, and has been with the Association continuously except for two periods. From 1943 to 1945, he was a senior stress analyst for special structural design problems for Republic Aviation Corporation, and in 1952 he took a leave of absence to supervise design of the first arch dam to be built in Japan.

Mr. Parme will talk on "Application of Shell Theory to Arch Dams." The equilibrium of forces and the relationship between stress and strain in a small element of an arch dam are established. Boundary conditions are considered so that designers can use the derived equation to set up simultaneous equations that can be solved readily by an electronic computer for the analysis of any arch dam.

Anton Tedesko, vice president, Roberts and Schaefer Company, consulting engineers, New York City, received civil engineering and doctor of engineering degrees from the University of Vienna, and an engineering diploma from the University of Berlin. After general design and construction experience with Doctors Melan, Dischinger and Finsterwalder, he joined his present firm in 1932, working progressively as designer, construction engineer and design manager in the Chicago office. During World War II, he headed the Washington office, and from 1945 to 1955 was manager of engineering design in the Chicago office. He has been responsible for design of many notable shell structures including the Hershey, Pa., Sports Arena, the San Diego Seaplane Hangar and the Limestone, Maine, Air Force Hangar of 340-ft. span, each of which was at the time the longest-span concrete building in the United States.

Mr. Tedesko will present "Design of Multiple Ribless Shells." An approach to the design of multiple ribless shells is developed. Large-scale model tests are described. Results of tests are compared with calculated values, and design criteria are evolved. A practical application of the use of these criteria is shown in the design of a major warehouse in the United States with cast-in-place multiple ribless concrete shells with a column spacing of 66 ft. by 39 ft.

Bruno Thürlimann, research professor of civil engineering, Lehigh University, received a diploma in civil engineering from the Federal Institute of Technology, Zurich, Switzerland, in 1946, and the degree of doctor of philosophy from Lehigh University in 1951. Before receiving his doctorate, he had two years of practical experience and research in shell roof construction at Lehigh. Subsequently, he was associated with the Federal Research Institute in Zurich and with the Graduate Division of Applied Mathematics at Brown University before returning to Lehigh in 1952.

Professor Thürlimann discusses "New Aspects Concerning Inelastic Instability of Steel Structures." Plastic design procedures impose more rigorous conditions on the stability of steel structures, necessitating a reconsideration of the problem of inelastic instability. Theories developed for members of a continuously strain-hardening material (such as aluminum alloys) cannot be applied indiscriminately to members of structural steel because this material exhibits an extended yield level at constant stress before the onset of strain-hardening. Secondly, residual stresses introduced by rolling and fabrication have a marked influence on the buckling strength.

George S. Vincent, bridge engineer, Division of Physical Research, Bureau of Public Roads, Washington, D. C., received the degree of bachelor of science in civil engineering from Oregon State College in 1916. After two years of railroad surveying and a short time with the U. S. Army Engineers, he joined the Bureau of Public Roads in 1919 as a highway bridge engineer. From 1927 to 1930, he was assistant bridge engineer for the Arkansas State Highway Department. He returned to the Bureau of Public Roads in 1930. From 1943 to 1954, he was a BPR representative in cooperative research on the aerodynamic behavior of suspension bridges at the University of Washington, including theoretical analysis and observations of the Golden Gate Bridge in San Francisco. Since 1954, he has engaged in aerodynamic studies, dynamic tests, and other bridge research.

Mr. Vincent presents a "Correlation of Actual Suspension Bridge Behavior with Predictions from Model Tests and Theoretical Analysis." Doubts concerning the validity of model tests and analysis as an indication of the behavior to be expected of a suspension bridge in the wind are based on (1) a possible scale effect, and (2) the difference between the natural wind and the wind used in the model tests. The first doubt may be discounted because scale effects in aerodynamic studies are generally related to streamlined flow rather than to the turbulent flow characteristic of wind about a bridge.

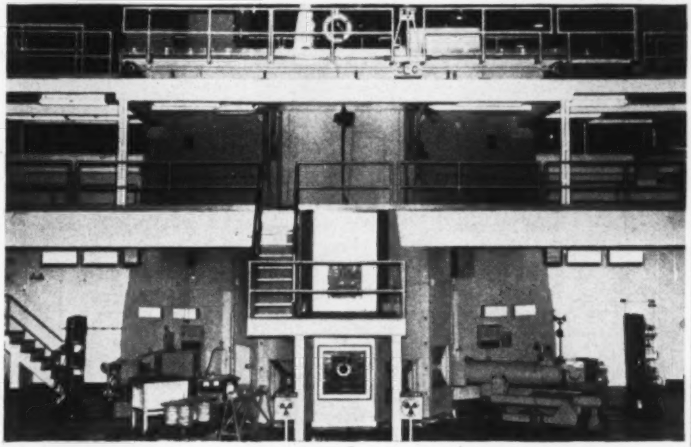
As to the second doubt, the best indication of uniformity and other characteristics of natural wind may be obtained by a comparison of the behavior of a suspension bridge with the behavior predicted from model tests. Studies on the Tacoma Narrows Bridge and studies of the Golden Gate Bridge are presented.

Charles S. Whitney, partner, Ammann and Whitney, consulting engineers, New York City, received the degrees of civil engineer, 1914, and master of civil engineering, 1915, from Cornell University. He was a consulting engineer in Milwaukee, Wis., for 24 years before entering his present partnership. During that period he designed bridges and many types of buildings, and was associated with Mead, Ward and Hunt in the design of Camp McCoy, Wis. During his partnership with Mr. Ammann, he has directed the planning and supervision of construction of many outstanding projects such as the Onondaga Memorial Auditorium, Syracuse, N. Y.; the Alabama State Coliseum, Montgomery; and hangars for airlines in many areas. He is especially associated with development of the plastic theory and ultimate strength design methods, and long-span concrete shell structures.

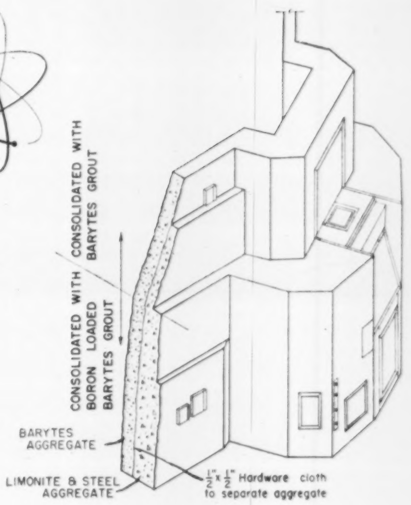
Mr. Whitney's paper is on "Design and Economics of Reinforced Concrete Folded Plate Construction of Roofs and Floors." Design methods for reinforced concrete folded plate shells are presented, and experience with the construction of folded plate roofs and floors for hangars, auditoriums, warehouses and other industrial buildings is discussed. Quantities of materials and costs are compared with other types of structures.

unique Prepakt wall shields nuclear research at Naval Laboratory

Official United States Navy photographs



Prepakt high-density concrete shield forms one end of Naval Research Laboratory "swimming pool" reactor. Behind shield reactor core is immersed in pool 40 ft. by 26 ft., 20½ ft. deep. Besides assuring safety from harmful radiation, Prepakt methods eliminated water leakage problems usually associated with difficult placement of conventional concrete.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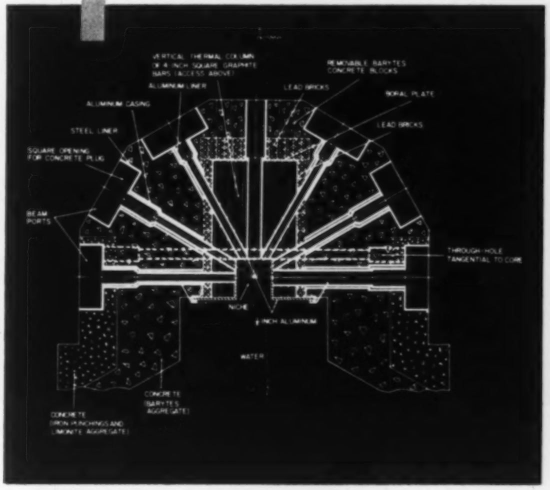
Prepakt concrete is made by consolidating preplaced aggregates with special grouts. For this concrete shield the aggregate nearest the core was barytes, for absorbing neutrons. Directly behind, a ½-inch mesh screen separates the barytes from a blended coarse aggregate consisting of limonite and steel punchings. This section was to stop gamma rays. All aggregates were precisely preplaced, then intruded simultaneously with a grout containing boron frits and barytes sand. When the grout level reached an elevation where less shielding was needed, the expensive boron frits was withdrawn from the mix and a straight barite grout used to complete the placement.

The Naval Research Laboratory Reactor in Washington, D. C. features one of the most unusual concrete biological shields ever constructed. According to specifications, the shield was to be composed of four different mixes of high-density concrete cast monolithically without cold joints. The complexity of mix design and the necessity for precise, uniform placement made it advisable to call in shielding concrete specialists. INTRUSION-PREPAKT was selected because its experience and unique methods were ideally suited to the project.

Safety, economy and operational effectiveness were all considered in designing this shield. It was desirable that it be as thin as possible to hold the length of beam ports to a minimum and thus intensify the neutron flux at the ports' outer ends. At the same time the shield must be dense and leak-free to assure personnel of complete safety. PREPAKT* high-density concrete provided the economical solution and met all conditions with an ease and sureness that goes hand-in-hand with experience.

Patented methods and materials in the hands of skilled personnel permit INTRUSION-PREPAKT to take jobs like this in stride. Tight schedules and difficult operating conditions are the rule rather than the exception. Whether your requirements are for high-density concrete or more conventional construction services, you will save time and money by calling INTRUSION-PREPAKT, INC., Room 568-0, Union Commerce Bldg., Cleveland 14, Ohio. European Division, Zurbaran 14, Madrid, Spain. In Canada, INTRUSION-PREPAKT, LTD., 159 Bay Street, Toronto, Ontario.


VERTICAL THERMAL COLUMN OF 4-INCH SQUARE GRAPHITE BARS (ACCESS ABOVE)
REMOVABLE BARYTES CONCRETE BLOCKS
ALUMINUM LINER
LEAD BRICKS
BORAL PLATE
ALUMINUM CASING
LEAD BRICKS
STEEL LINER
SQUARE OPENING FOR CONCRETE PLUG
BEAM PORTS
THROUGH-HOLE TANGENTIAL TO CORE
NICHE
INCH ALUMINUM
WATER
CONCRETE (BARYTES AGGREGATE)
CONCRETE (IRON PUNCHINGS AND LIMONITE AGGREGATE)

Horizontal cross section through Prepakt shield illustrates necessity for using concrete that assures complete embedment of beam ports and a tight bond to metal inserts.

INTRUSION-PREPAKT, INC.

OFFICES IN PRINCIPAL U. S. AND FOREIGN CITIES

*Intrusion and Prepakt are trade marks of Intrusion-Prepakt, Inc., whose methods and materials are covered by U. S. Patents Nos. 2313110, 2655004, 2434302 and others, also patents pending.

THE YOUNGER VIEWPOINT

Committee on Junior Member Publications

Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.

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This is the second of your Younger Viewpoint series. As noted last month, these articles will attempt to report on the current younger thinking in ASCE circles (and their fringes).

Again, please let me emphasize that this will be *your* column. It will be your voice and mine—ours to use as we will.

Your letters form the major portion of the article. Please write your Zone Chairman or me to sound off about professional and other ideas that are worth considering.

John Locke said, "I attribute the little I know to my not having been ashamed to ask for information, and to my rule of conversing with all descriptions of men on those topics that form their own peculiar professions and pursuits."

Our main item considers the work of an energetic group of young engineers:

In 1957 the Juniors of the Pittsburgh Section surveyed the salary situation for young engineers in that area. Theodore B. Ray was chairman of the five-man Salary Survey Committee that received 186 replies to a questionnaire mailed to 476 Juniors. A splendid analysis and valuable report were prepared. Some of the particularly interesting points are summarized here:

First, the sampling indicated that 98 percent of the younger engineers were employees and that 40 percent were in industry, 23 percent in construction, 18 percent in consulting offices, and the remainder distributed in small percentages in other fields.

Fig. 1 shows basic data on actual monthly salary and desired monthly salary plotted against years of experience. This is a composite graph for all civil engineers reporting. The curves indicate a general rise in monthly earnings with years of experience, although a leveling off is indicated at about eight years of experience. The discrepancy between actual and desired monthly salary becomes substantially higher after about five years experience.

Fig. 2 shows the same information but is plotted against age rather than years of experience. Comparison of actual monthly salary curves on Fig. 1 and Fig. 2 on the basis of everyone graduating at the age 22 (zero years of experience) shows the curve of Fig. 1 to be higher than that of Fig. 2. This indicates that employers rate maturity as well as experience when establishing salaries.

An inspection of the previous curves indicates a drop in salary in relation to years of experience beyond seven years. There were scant data for these points, however, and the data are not conclusive. One might infer, however, that all things being equal, the benefits of higher starting salaries in recent years have not been extended to older engineers already employed in a company.

Fig. 3 shows a cumulative distribution of actual and desired income.

In plotting Fig. 4, the base salary was considered to be $450 per month for the 1957 graduate. The term, value of experience (VE), is the percentage of base per year of experience and was calculated as follows:

$$VE = \frac{\text{Salary} - 450}{450} \times \frac{100}{\text{years of experience}}$$

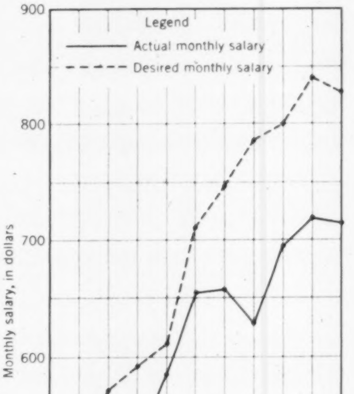


FIG. 1

Questions 18 and 19 of the questionnaire were interesting and are presented here with the accompanying responses.

18. How do you rate fringe benefits at your present place of employment?

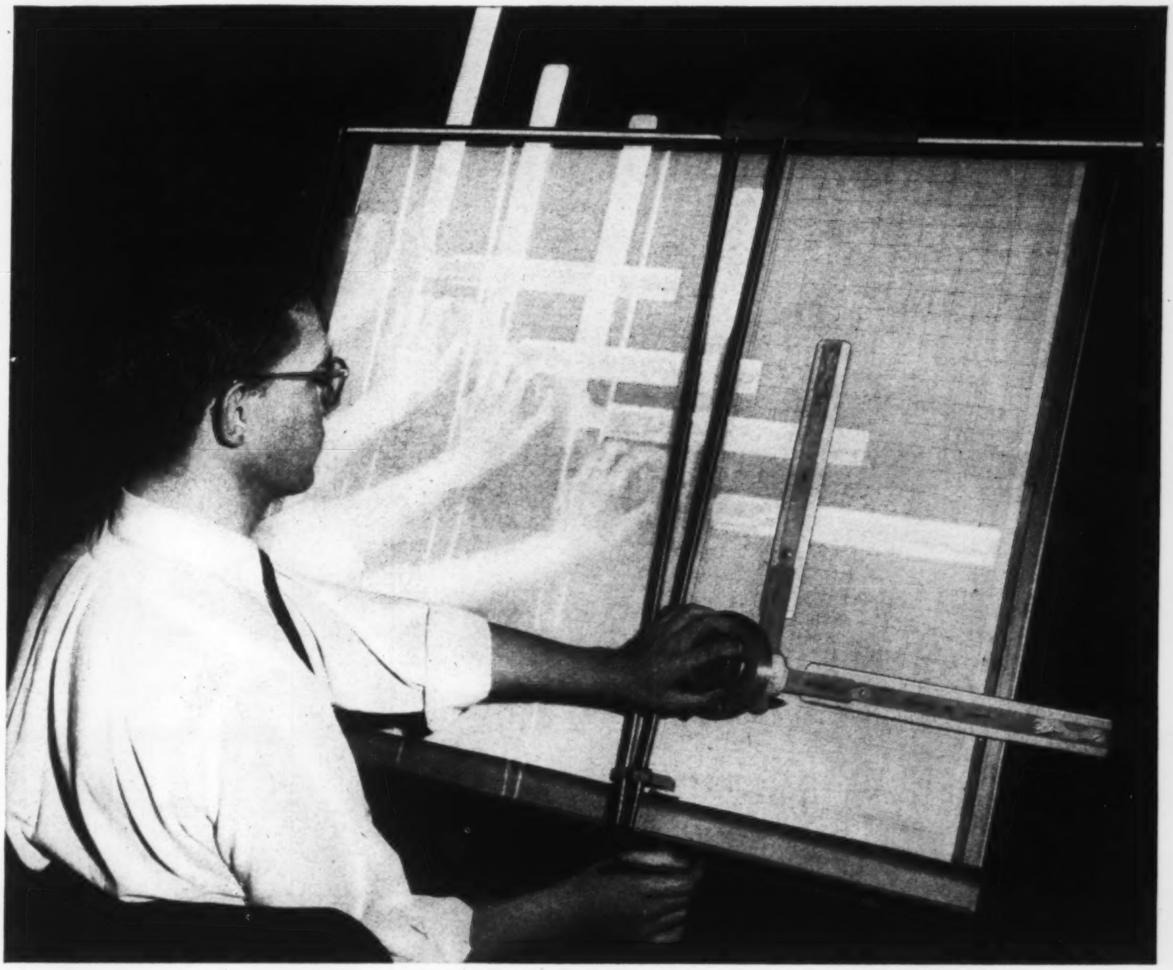
Good	Fair	Poor	None
50%	34%	8%	8%

19. With respect to your conditions of employment, how do you rate the following items?

	Good	Fair	Poor
a. Effective use of your engineering training	40%	45%	15%
b. Opportunity for advancement	41%	40%	19%
c. Recognition of your preference in work assignments ..	40%	40%	20%
d. Quality of supervision	45%	42%	13%
e. Employee-management relations	54%	36%	10%
f. Overall satisfaction	49%	44%	7%

The Pittsburgh committee drew some general conclusions from their survey:

1. Salaries are based on demand and age as well as on experience.
2. In general, as salary increases, the difference between the actual and desired salaries increases.
3. Frequent job changes, in general, do not yield higher salaries.
4. The majority of engineers reporting rated fringe benefits as good.
5. Reported salaries in the Pittsburgh district are somewhat above the reported salaries in the San Francisco district. However, it should be remembered that the San Francisco survey was conducted in 1956, while the Pittsburgh survey was conducted nearly a year later.



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The first time you use it, you'll know that K&E's light-weight Paragon® *Auto-Flow*™ Drafting Machine is a truly great advance in working ease and range. Here are 5 *specific* reasons why.

It's more versatile. Stays in perfect balance at any board angle, from vertical to horizontal. No adjustments needed, except a simple turn of a tension spring wheel for angles below 15 degrees.

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The 30" by 40" *Auto-Flow* costs only $148.50 . . . the 36" by 60" only $160. All standard sizes; left-hand models available. Mail coupon for details. 1265

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Name & Title: ____________________

Company & Address: ____________________

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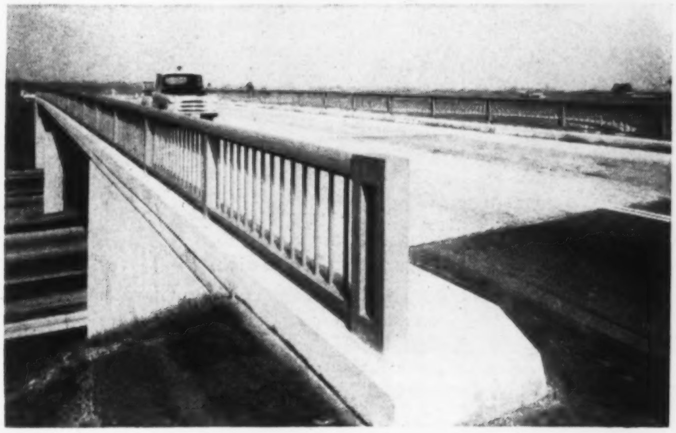

For simplicity of design and availability you can count on USS Structural Steel

It is generally accepted that the best design is the *simplest* design. This is especially true in bridges.

A clean, simple structure indicates that the designer refused to use one extra pound of material. He had a clear understanding of fabrication problems, so he carefully eliminated excess joints. He knew that *men* had to do the erection, so he selected familiar, easy-to-work-with materials.

For these reasons, most designers prefer to work with steel.

Steel is the most versatile of all building materials. It can be punched, sheared, hot-worked, welded, flame-cut, riveted or bolted. Members can be fabricated in the shop and erected in practically any kind of weather. It is unsurpassed for strength and impact resistance, and is available in a great range of shapes, sizes and strengths.

Long before the Interstate Highways Program was suggested, the steel industry saw the growing need for structural shapes and plates. New facilities were planned, and today they are steadily coming into production. Bridges that are on the drawing board today can count on these new facilities. Now, more than ever before, you can design with the material you know best, the material that offers the most—*you can count on steel.*

USS
TRADEMARK

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel

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ROADS
ON THE GO

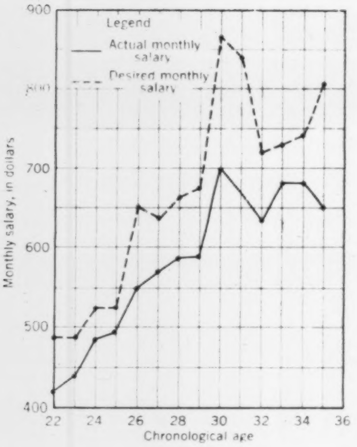


FIG. 2

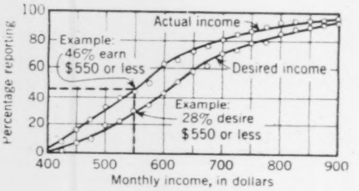


FIG. 3

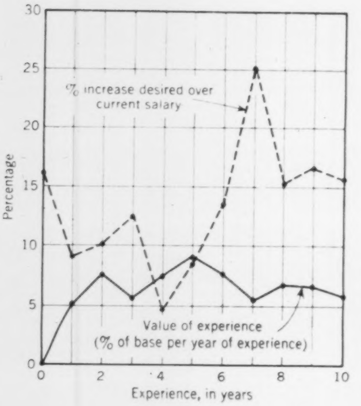


FIG. 4

So much for some young ideas and doings for this issue.

Please write soon so that our communication of ideas will increase.

ASCE leaders recommend that Juniors change grades to Associates as soon as possible. What are your thoughts on the matter?

What would you say to changing the title of this column to "The Civil Young"?

Hope to meet you at the October Annual Convention in New York.

Division Doings

Discussion of Professional Registration

With the status of the professional man in the world today changing so rapidly, the City Planning Division has planned a panel on professional registration with particular emphasis on registration as it concerns the fields of city and regional planning. The panel, which will be held on Tuesday afternoon, October 14, will be one of the scheduled sessions of the Society's October Convention in New York.

Everett Mansur, M.ASCE, a member of the Executive Committee of the Division, will serve as presiding officer of the panel. Panelists have been chosen to represent the many attitudes towards registration. They are: Paul Robbins, executive secretary of the National Society of Professional Engineers; Dennis O'Harrow, executive director of the American Society of Planning Officials; Frederick C. Clark, chairman of a committee on professional registration of the American Institute of Planners; and E. Lawrence Chandler, M.ASCE, Assistant Secretary of ASCE.

Aside from the implications of registration in the field of city planning, the question of registration applies to all branches of the profession. Because members of the City Planning Division feel that the problem is an important one, the Division extends an open invitation to all members of the Society to attend and participate in the panel discussion.

Anniversary Luncheon of City Planning Division

In observance of its 35th anniversary, the City Planning Division will hold a kick-off luncheon for its program scheduled during the October Convention. On Monday, October 13, the Honorable Prescott Bush, U. S. Senator from Connecticut, will speak to members on "Redevelopment and Urban Renewal." A member of the Senate subcommittee responsible for the new Urban Renewal Legislation in the 1958 Congressional Session, Senator Bush will bring expert opinion to bear on his timely topic.

Special invitations have been issued to those men who have served as chairmen or members of the Division's Executive Committee during the 35 years of its existence. All members of ASCE are invited to join with the members of the City Planning Division at this 35th anniversary luncheon.

Electronic Computation Conference

The Kansas City Section and the Structural Division are readying plans for their Conference on Electronic Computation, to be held in Kansas City, Mo., on November 20 and 21. Additional papers have been received and the committee plans to have papers on all levels so that valuable information will be available to design engineers, engineering administrators, engineers engaged in programming, and those working at all stages of computation.

Some of the projected sessions are: outstanding applications of computers in structural analysis, design and research; numerical methods and their relation to design; programming and coding of structural problems; and organization of computer groups in engineering offices. Arrangements have been made with computer manufacturers for exhibits and demonstrations during the conference.

A complete program of the conference will appear in the October issue of Civil Engineering. Information is available from Secretary Steven J. Fenves, 203 Civil Engineering Hall, University of Illinois, Urbana, Ill.

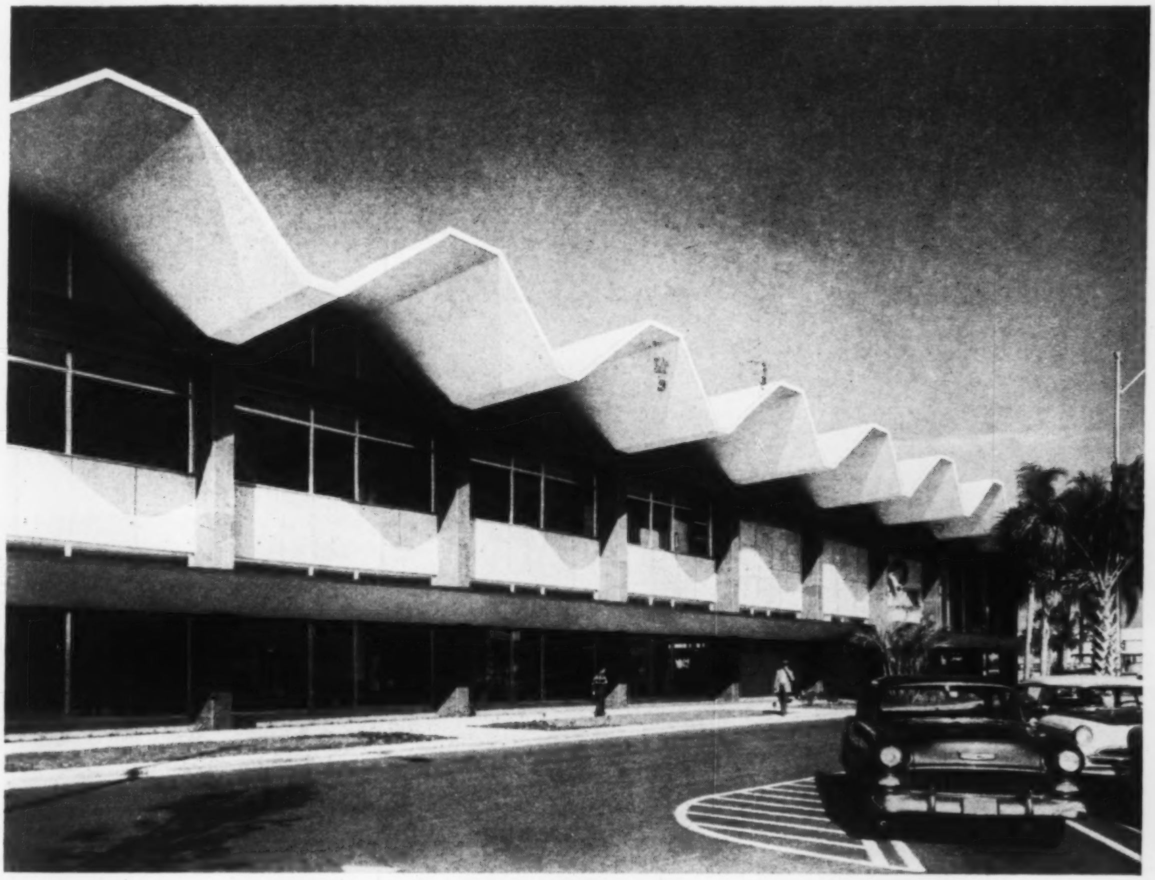
Construction Division Meeting

"Foreign Construction" will be the theme of the Construction Division's session at the Annual Convention, with the aim of broadening the horizon of ASCE members. The Division will hold its meetings on Monday, October 13, in morning and afternoon sessions. The services of experts have been obtained for the presentation of papers at both sessions. In the morning, members will hear Henry C. Boschen, M.ASCE, vice president of Raymond International Incorporated, and George Havas, M.ASCE, vice president and general manager of the Henry J. Kaiser Company's Heavy Construction Division. At the afternoon meeting, speakers will be A. D. McKee, president of Perini Limited, and Daniel Del Rio, representative of the Banco National de Cuba.

Aside from Convention plans, the program committee has been busy with projects for the future. Chairman John Senesy, M.ASCE, reports that plans have been completed for several meetings, including the October 1959 Convention in Washington, D. C.

New editor of the News Letter is Howard Jacoby, who invites contributors to send items to him at 1826 Ashland Avenue, Columbus 12, Ohio.

WHEN AMERICA BUILDS FOR ECONOMY . . . IT BUILDS WITH CONCRETE



Sears, Roebuck & Company's Tampa store . . .

concrete folded plate roof achieves large, unobstructed floor area

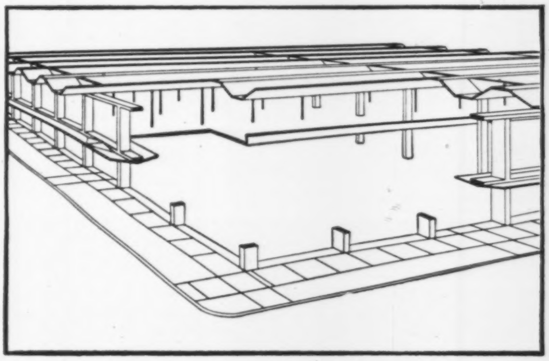
One of the basic requirements here was to achieve unobstructed floor space with economy. Architects Weed, Russell, Johnson & Associates found the answer by using a concrete shell in the form of a folded plate. This construction made it possible to span the entire floor area with only one interior row of columns . . . and suspend the second floor from the roof. The result: 163,715 square feet of *fully flexible* floor space, so important to any retail selling operation.

Folded plate design is, in itself, unique and interesting. And only concrete can give the added boldness of the wide, cantilevered overhang.

It's one more example of the way new uses of concrete are bringing big economies and added vitality to both conventional and modern architecture.

PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of concrete



Isometric view showing 125-foot c on c spacing of main columns. Floor slab is supported by 3-inch plates welded together to form a hanger. Hangers are spaced 25 feet c on c.

FOR STRUCTURES...
MODERN
concrete

ASCE Membership as of August 8, 1958

Members	10,074
Associate Members	14,145
Junior Members	17,269
Affiliates	77
Honorary Members	47
Total	41,612
(August 9, 1957	40,375)

Engineering Foundation Grants Go to 26 Projects

Continuation of studies that are steadily reducing the cost of reinforced concrete construction; another study that will eliminate uncertainties in the properties of high-temperature and high-pressure steam for power generation, whether from coal, oil or atomic heat; still another aimed at reducing our huge annual losses from metallic corrosion—these are just a few of the important research projects that are receiving Engineering Foundation support.

At a recent meeting held in New York, Engineering Foundation announced grants of $71,500 to advance research in the 1958-1959 fiscal year. These new allocations will further twenty-six projects that will also receive nearly $1,000,000 outside support from industry. The projects, to which funds have been allocated, represent all the important branches of the engineering profession. They are being carried out in university, government, and industrial laboratories all over the country under sponsorship of the major engineering societies.

Typical of the studies receiving Engineering Foundation support is the program of the twelve-year-old Column Research Council. Organized by the ASCE to conduct research on structural colums, the Council has produced findings that permit greater economy of design without sacrifice of safety. In addition to its regular program, the Council is currently preparing a guide to specifications for metal columns and other members with capacity limited by stability. The guide will correlate the results of the extensive analytical and experimental work done by the Council with other available data.

The destructive effects of wave action on Fire Island and the south shore of Long Island (New York) this past winter dramatically underscore the importance of another project that continues to receive Engineering Foundation support. The Council on Wave Research is an independent program set up to help combat the universal problem of eroding beaches. In its eight years of existence, the Council has sponsored six conferences on different phases of coastal engineering. The sixth conference, held at the University of Florida last December, attracted a wide attendance from foreign countries. Invitations to hold the seventh conference abroad have already been received from Portugal, England, and Holland.

This year Engineering Foundation is making an initial grant to a program concerned with Documentation in Engineering—a joint project of the four Founder Societies, the American Society for Metals, and Western Reserve University. The Council on Documentation Research was established at Western Reserve two years ago to promote wider use and better understanding of recorded scientific and technical information. Its long-range goal is to stimulate research and development in the field, to encourage the cooperation of those actively concerned with documentation, and especially to make the enormous volume of engineering research being published today more readily available to practicing engineers.

Formed in 1914, Engineering Foundation was a pioneer in recognizing the importance of research. Its current endowment fund is about $2,000,000. Though the income from this fund is very modest in comparison with present-day research outlays, the Foundation has through the years initiated and kept alive many important research programs that were later able to obtain large-scale financial backing from industry.

ASCE QUARTERLY ENGINEERING SALARY INDEX

Consulting Firms

City	Current	Last Quarter
Atlanta	1.11	1.11
Baltimore	1.11	1.11
Boston	1.15	1.13
Chicago	1.30	1.26
Denver	1.22	1.19
Houston	1.12	1.08
Kansas City	1.14	1.14
Los Angeles	1.16	1.16
New York	1.20	1.17
Pittsburgh	1.05	0.93
Portland (Ore.)	1.15	1.15
San Francisco	1.19	1.17
Seattle	1.06	1.07

Highway Departments

Region	Current	Last Quarter
I, New England	0.91	0.85
II, Mid. Atlantic	1.17	1.17
III, Mid. West	1.25	1.15
IV, South	1.09	1.07
V, West	1.00	0.97
VI, Far West	1.15	1.15

Figures are based on salaries in effect as of May 15, 1958. Base figure, the sum of Federal Civil Service, G. S. Grades 5, 7, and 9 for 1956, is $15,930.

ASCE CONVENTIONS

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 13-17, 1958

LOS ANGELES CONVENTION
Los Angeles, Calif.
Hotel Statler
February 9-13, 1959

CLEVELAND CONVENTION
Cleveland, Ohio
Hotel Cleveland
May 4-8, 1959

TECHNICAL DIVISION MEETINGS

IRRIGATION AND DRAINAGE CONFERENCE

Memphis, Tenn.
September 25-27
Sponsored by
ASCE Irrigation and Drainage Division
ASCE Mid-South Section

CONFERENCE ON ELECTRONIC COMPUTATION

Kansas City, Mo.
Continental Hotel
November 20-21
Sponsored by
ASCE Structural Division
Kansas City Section

LOCAL SECTION MEETINGS

Los Angeles Section—Soil Mechanics Group dinner meeting at the Rodger Young Auditorium, September 17, at 6:30 p.m.; Construction Group dinner meeting at Bill Storey's Restaurant, September 18, at 6:30 p.m.; Junior Member Forum dinner meeting at Pike's Verdugo Oaks, September 18, at 6:00 p.m.; Sanitary Engineering Group dinner meeting, at the Engineers' Club, Biltmore Hotel, September 24, at 6:30 p.m.; Transportation Group dinner meeting at the Engineers' Club, Biltmore Hotel, September 25 at 6:30 p.m.

Nebraska Section—Dinner meeting at Nebraska Memorial Union, September 17, at 6:30 p.m.

Texas Section—Fall meeting in San Antonio, September 25-27. Meeting of the Houston Branch at the Houston Engineering & Scientific Society, September 16, at 8 p.m.

46 years old and still in service

This 60-in.-ID steel water main, photographed a few months ago, was installed in 1912. It has been in constant service for 46 years delivering raw water to Denver, Colorado. In the words of the Water Department: "This pipe is in very good condition and is still giving satisfactory service."

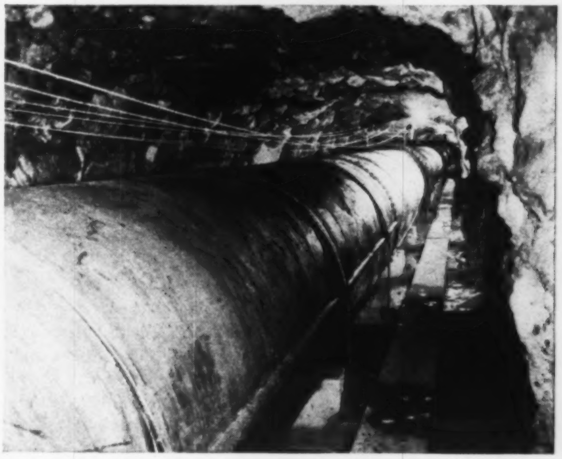
The 1111-ft main is of lockbar construction, fabricated from ⅜-in. plates, with an Ovarco lining. Its exterior was originally coated with an asphalt paint, and the exposed portion shown here has been re-painted from time to time. About 700 ft of the main extends through a tunnel, while the elevated section shown above spans the South Platte River.

20° below to 100° above — The temperature range of the atmosphere is roughly 120 deg, while the water itself varies from 32.5 to about 70 deg. This has caused no difficulties. As the Water Department states: "Steel pipe does not require any protection from temperature extremes."

Through the years Denver has installed about 17 miles of large-diameter tar-enameled steel pipe for the city's pipe system, as well as many more miles for its collection conduits across the Continental Divide.

Every length is tested — There's no guesswork with steel water pipe. Every length is hydrostatically tested in the shop according to AWWA specifications, ordinarily to twice the working pressure! There's no other pipe so strong, so reliable under all service conditions, as tar-enameled steel pipe.

Let us quote on your next project.



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BETHLEHEM STEEL

BETHLEHEM STEEL

BY-LINE WASHINGTON . . . .

The engineering aspects of the nation's civil defense hit the headlines last month when federal officials asked Congress for a supplemental appropriation of $29 million, of which $5.8 million would be used to advance their prototype shelter program. And just a few days later a House Committee released its report on the feasibility of atomic shelter programs.

This highly controversial subject continues to rage beneath the surface and each time it boils up it reveals more disturbing aspects. All other construction programs pale in comparison with the tremendous responsibilities a shelter program would place on the shoulders of the nation's civil engineers. Here are only a few facets of the problem.

Both the Administration and Congress now refuse to countenance any kind of shelter program to protect the citizenry against the *blast* of nuclear explosions. Lives lost within target areas just must be written off, they say. It would cost at least $115 billion to provide underground shelters deep enough and heavily enough armored to provide protection for even a fraction of the people working in a congested urban target area. Chances are that the warning period would be too short (3 to 20 minutes) to permit them to reach these shelters in time, anyway.

The defense planners have shifted their sights to the problem of preserving the even greater proportion of population which would be subjected to the hazards of *fall-out*. It is around the possibilities of this program that the present controversy is turning here in Washington.

It would cost $22 billion to build enough shelters to protect Americans (outside of the immediate target areas) from fall-out, expert witnesses testified. If the resources of the entire construction industry were concentrated on such a program, they could be constructed, theoretically, within five months. After a state of emergency were declared, it would take 16 months. However, there is apparently no question but what the engineering profession could design adequate fall-out shelters or that the industry could produce them, given the time.

The stickler is the money, Congressmen repeatedly averred. It would cost from $84 to $119 per person to build and stock several types of fall-out shelters, one expert estimated. The most expensive (per person) would be the underground family-type shelter—$3,150. Others less costly would be an underground garage shelter for 500 persons—$167,000. And a 110-ft diameter dome shelter with three interior stories completely stocked and equipped to protect 2,000 people would cost $392,000.

Advocates of the fall-out shelter program appealed for speedy adoption of such a construction program. Dr. Ellis Johnson of Johns Hopkins University was one of those who testified to the marginal value of blast shelters but the merits of fall-out protection. "We simply must have fall-out shelters," he insisted.

The boldest shelter concept was that offered by Guy B. Panero, consulting engineer of New York City. The Panero firm probed the possibility of deep-rock shelters beneath major cities. The total daytime population of Manhattan, for example, could be accommodated 800 feet under that island in massive vaults. For $680 per person, this shelter would provide all the necessities of life for 90 days, it was reported. And tunnels to the boroughs could be built so people could migrate to the surface as it became safe.

The committee was highly offended by the suggestion. Such fantastic schemes are bound to encourage ridicule of the whole shelter investigation, they declared.

Several witnesses told the Congressmen that enough technical design data are available now to start a shelter construction program. However, there is still much to be investigated. Both the Army and Navy engineers reported numerous studies completed since 1948. Dr. Nathan M. Newmark, M.ASCE, University of Illinois, listed a few of the unknowns in shelter design. He pointed out that (1.) Blast and shock loadings on structures are still subject to "major degrees of uncertainty." (2.) Some uncertainties still exist in the reaction of materials themselves to high-speed loading. (3.) Little or no information is available on the dynamic behavior of foundation elements to support structures. Major savings in cost of construction and design could be achieved with further information in this area, he said. The greatest lack of knowledge is in design of entrances. Pressure build-up in ramps and passageways creates unique problems.

The federal civil defense agency would proceed much more reasonably than most of the shelter advocates. Its request last month was for a modest $29 million to be used for research and education, including the following:

- Survey a limited number of existing structures to determine their shelter potential.

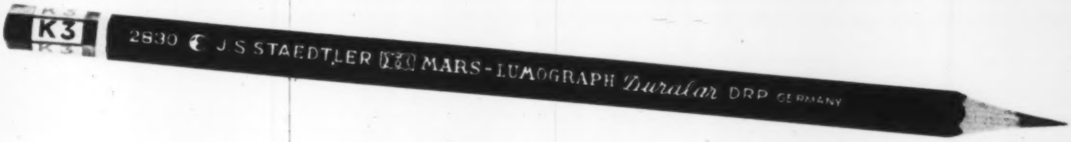
- Work with engineering schools to broaden the knowledge of design requirements.

- Construct a few prototype dual-purpose shelters in underground parking garages, understreet shelters, subways and in new additions to schools and hospitals.

- Incorporate shelters in new federal buildings as a good example to states and cities.

Beyond this, however, Leo A. Hoegh, director of the Office of Defense and Civilian Mobilization, told the Senate Finance Committee, shelter protection will be the responsibility of the individual.

Apparently the Senators felt much the same way. In fact, the Finance Committee knocked out the whole program described above. But they did give the agency $3 million to help it educate the American people to the dangers of nuclear warfare and how to take care of themselves in case of attack—with three minutes warning.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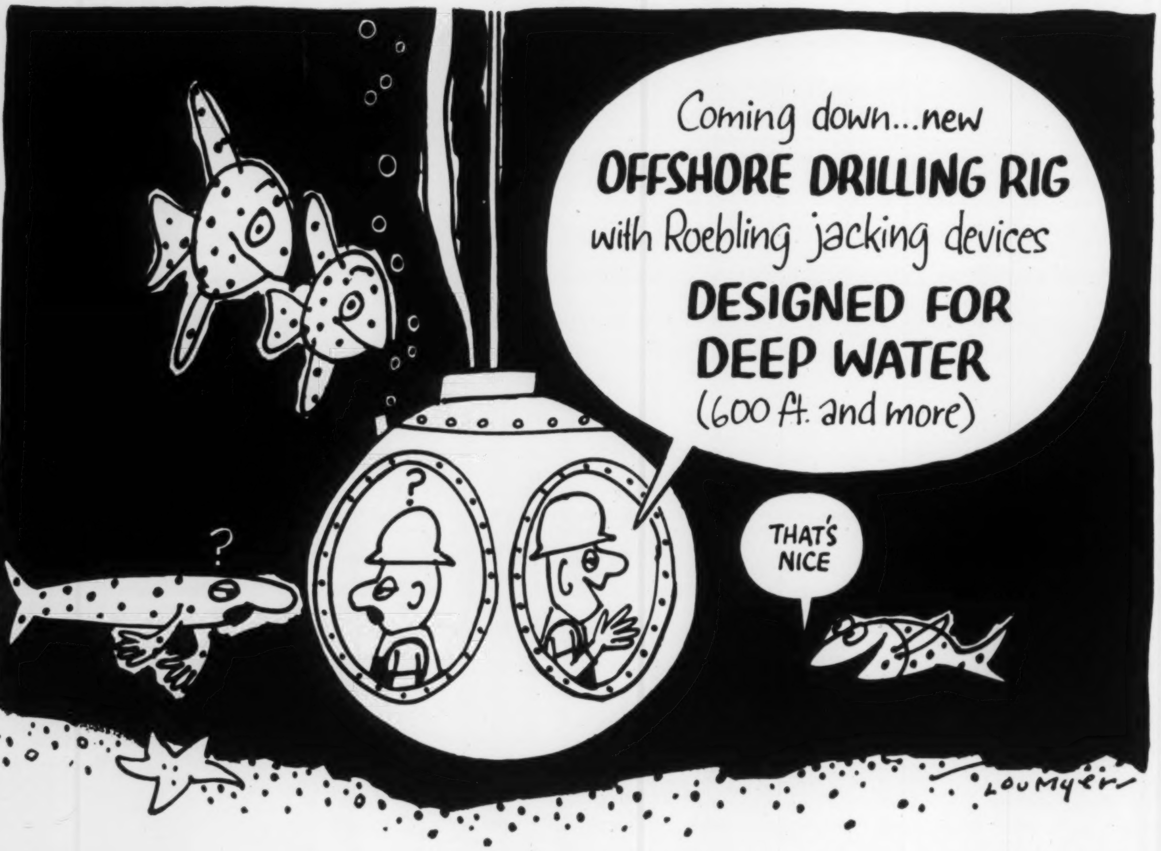
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Expressly designed for deepwater locations, this equipment enables drilling where present types cannot operate.

The rig (Figure A) is towed to the drilling site in a buoyant condition, with both the anchor and deck float dewatered. At the drilling site, the anchor is gradually filled with water and lowered to the bottom by the jacking equipment. Once at the ocean floor, the anchor is completely filled with water, firmly seating it on the bottom.

While this operation is in progress, the buoyant float (Figure A) remains on the surface. Once the anchor is seated on the bottom, the Roebling jacking equipment goes into operation to bring the deck float down to operating position, which is at a predetermined level below the area wave action (Figure B).

When the drilling rig is to be moved to another area, the jack action is reversed. Strand is released to raise the deck float to the surface. The anchor float is pumped out sufficiently to permit the jacks to raise it to traveling position, under the deck float. During all of these raising and lowering operations, the strand is spooled up and payed off by means of power operated storage reels.

This is another example of how Roebling suspension systems and their principles can be – and are constantly – applied in the unlikeliest of places. Roebling's design, construction and service abilities range far and wide, embracing pipe line bridges, material and personnel tramways, ski lifts, guyed towers, suspended roofs and *suspension systems of all kinds.* The experience and knowledge gained from these activities prompts us to invite inquiries on any suspension project. Bridge Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

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FIG. A

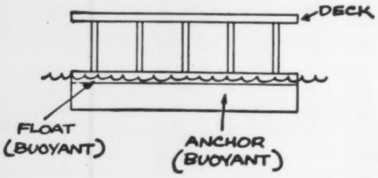
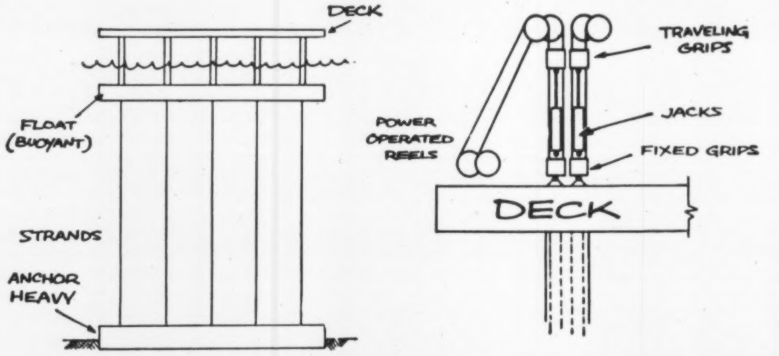

DECK
FLOAT (BUOYANT)
ANCHOR (BUOYANT)

FIG. B


DECK
FLOAT (BUOYANT)
STRANDS
ANCHOR HEAVY
TRAVELING GRIPS
JACKS
POWER OPERATED REELS
FIXED GRIPS
DECK

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LAPIDOLITH* was first applied to the concrete flooring, making it many times harder than ordinary concrete, and dustproof;—followed by a coating of SonNoMar, Light Gray, to give the concrete floors beauty and utility. The tough, smooth, sealed surface is not only easy to keep clean, but has also resisted the constant scuffing of almost 2,500,000 pairs of feet last year.

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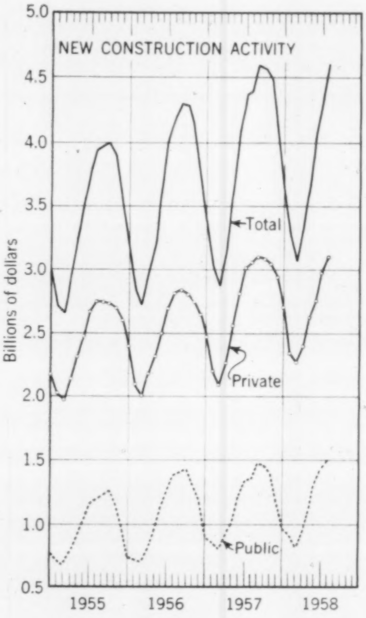
NEWS BRIEFS . . .

Construction Activity Indicates Record Dollar Year

New construction activity rose seasonally in July to $4.6 billion, according to preliminary estimates prepared jointly by the U. S. Departments of Commerce and Labor. The total dollar volume for the first seven months of 1958, amounting to $26.7 billion, was up slightly from the comparable 1957 period. Outlays in July set a new record for that month, exceeding by 3 percent the previous July high established a year earlier, when construction activity was reduced by shortages of cement and concrete products, as revealed by special surveys made at that time.

The latest estimates reflect a 5-percent rise in public construction from the first seven months of 1957, due primarily to increased spending for highways and public housing (mostly Capehart projects for the armed services). Private construction thus far in 1958 amounted to $18.6 billion, only slightly below the total for the same 1957 period, despite the sharp drop in industrial construction outlays. Expenditures for residential building were about the same as a year ago, for the first seven months, and accounted for nearly half of the private total in both years. (For the basis of this government estimate see Civil Engineering, August 1958, p. 88.)

Other indicators of construction activity all point to a record high year in dollar volume of construction, influenced by a continued rise in prices generally and specifically by the hike in steel and lumber costs. Road construction is not appreciably higher than last year but is expected to increase with some new contract awards.



Cumulative seven-month total of private construction is 1 percent less than 1957 but total construction is up 1 percent.

Steel Prices and Shipments Rise

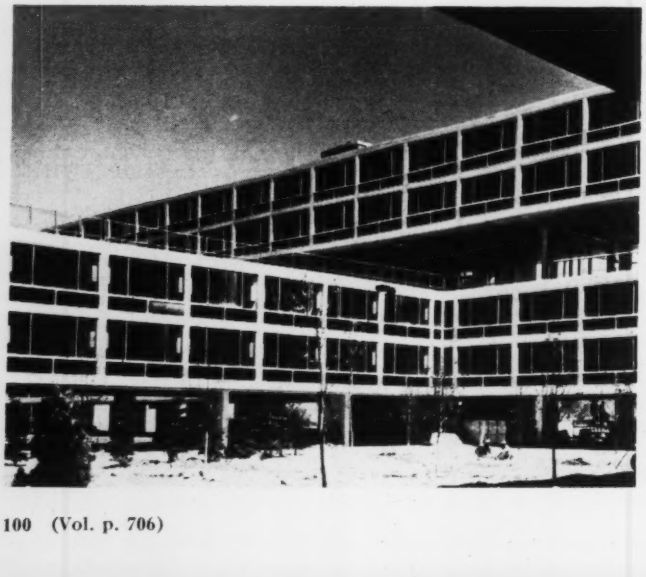
Flat rolled steel led a parade of advances in steel prices with a rise of about $4.50 per ton in late July. Reinforcing steel, bars and structural shapes followed, showing an increase of $5.00 or more in early August. A rise in labor costs is given as the reason for the advances, but suppliers say the rise is not adequate to cover actual increases in wage rates, agreed on sometime earlier. Base prices of steel at eastern and central mills of the U. S. Steel Corporation are now 5.6 to 6 cents a lb for reinforcing and 6.7 to 6.9 cents for bars and structurals.

Warehouse prices range from $150 to $190 per ton for reinforcing, depending on freight distance from the mills, size and quantity extras. Structural shapes range from $175 to $200 per ton.

The Aluminum Company of America advanced the price of primary aluminum 0.7 cents to 24.7 cents a lb, a reversal of a 2-cent drop last April. Other aluminum producers are expected to stay in line with this advance.

Finished steel shipments increased more than one million net tons in June 1958, as compared to May 1958, according to the American Iron and Steel Institute. Shipments to each of three leading markets—warehouses and distributors, automotive, and construction, including maintenance—were up more than 200,000 tons.

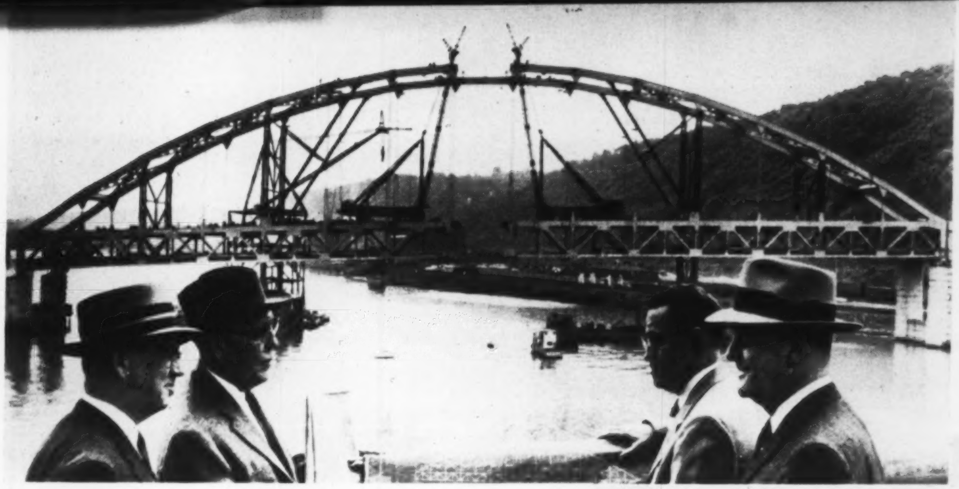
During the first half of 1958, steel mills shipped 28,699,218 net tons of finished steel products, against 44,285,435 tons in the first half of last year.



Aluminum Curtain Walls Are Feature of Air Force Academy

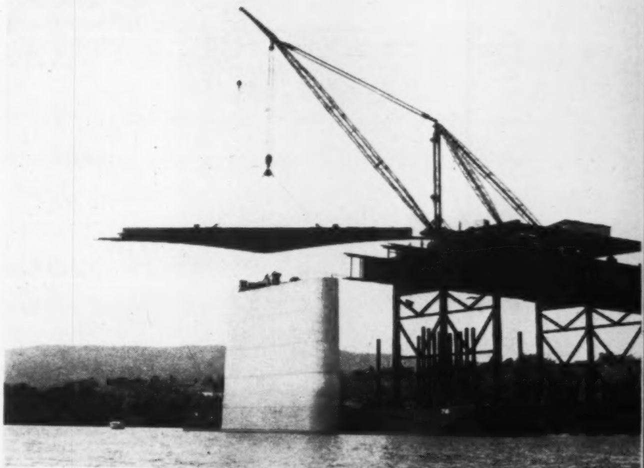
The Air Force Academy at Colorado Springs, Colo., is making architectural use of more than 5,000,000 lbs of aluminum. The imposing educational institution will feature curtain walls of aluminum and glass on every major building. Shown here is new Cadet Quarters Building, giving view of extrusions. Largest aluminum extrusions ever produced for architectural purposes, exterior beam covers ranging in size up to 24 in., were fabricated by Alcoa at its Lafayette (Ind.) works, on a 14,000-ton extrusion press, operated by Alcoa for the Air Force. Cupples Products Corporation, St. Louis, Mo., was the aluminum subcontractor for several buildings. Designed by Skidmore, Owings and Merrill, Chicago, Ill., the gleaming aluminum and glass buildings symbolize the spirit of flight.

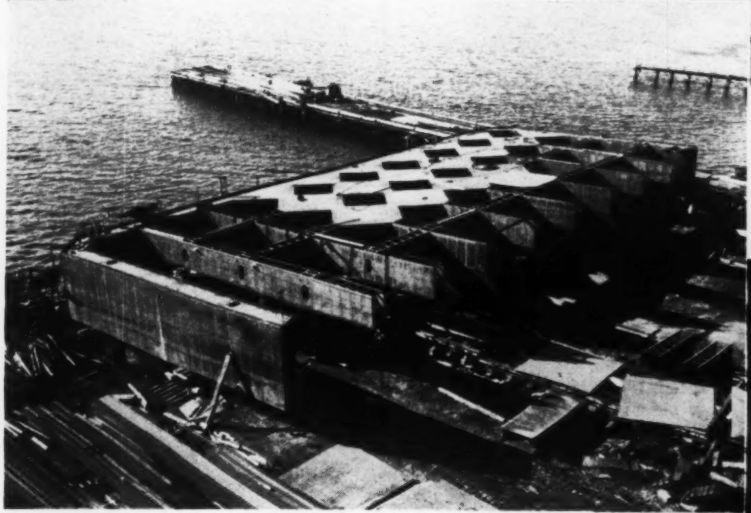
BRIDGES IN THE NEWS



↑ A closing 74-ton piece is hoisted into the double-deck, 750 ft span, tied-arch Fort Pitt bridge across the Monongahela River at Pittsburgh. High-strength steel is used for two-thirds of the span's 8,500 ton weight. In the foreground, l to r, are: Allan A. Porter, American Bridge Division's Vice President-Erecting; George S. Richardson, consulting engineer, designer of the bridge; Leonard J. Curran, District Engineer, Pennsylvania Department of Highways; and Arthur S. Marvin, Vice-President-Engineering, American Bridge Division of U. S. Steel.

A continuous plate-girder structure, 275-375-275 ft, will span the channel of the Tennessee River at Chattanooga. A. F. Hedman designed the bridge for the Tennessee Department of Highways. Bethlehem Steel Company is fabricating and erecting the bridge, which will have a total length of 2,641 ft. ↓

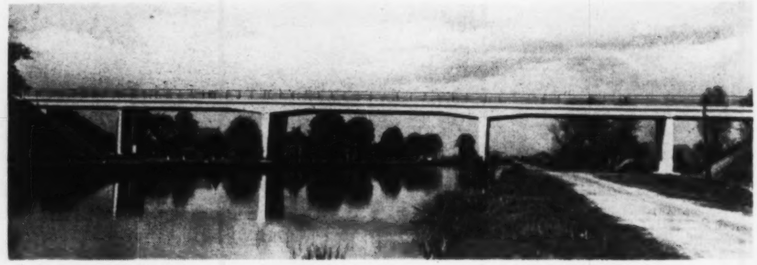




↑ Cutting edges for open caisson for tower piers of Throggs Neck Bridge connecting Bayside, Queens, with the Bronx were fabricated at Yonkers, N. Y., by J. K. Welding Co., Inc. and towed to bridge site. This unit, 13 ft deep, 75 ft wide and 162 ft long, weighed 450 tons at launching. Merritt Chapman & Scott Corp. have the general contract for the two tower piers; Ammann & Whitney, are engineers for the Triborough Bridge Authority.

Shear plates on top of 38-ft glued-laminated timber girders utilize the concrete deck to make a low-cost composite structure. Girders are fabricated by Timber Structures, Inc. for use on Oregon county roads. ↓

Magnificent Congress Hall, Berlin, scene of Congress here reported, has cable-supported roof suspended from two inclined arches.



Recently constructed viaduct near Kloosterdije, Netherlands, consists of short precast prestressed beams joined at points of zero moment in span by transverse prestressing to provide long-span continuity.

Prestressed concrete roof trusses for hangar of Transair Ltd., Gatwick Airport, Great Britain, have span of 105 ft.

Graceful prestressed-concrete water tower recently completed in Orebro, Sweden, has capacity of 1¼ million gal.

Advances in Prestressing Reported

At Third Congress of International Federation of Prestressing, Berlin

DAVID P. BILLINGTON, J.M. ASCE, Project Manager, Roberts & Schaefer Co., New York

A STRIKING prestressed concrete structure, designed through international cooperation, formed a most appropriate setting for the Third International Congress on Prestressed Concrete held in Berlin in May 1958. The brand new and magnificent Berlin Congress Hall was the scene for the gathering of about a thousand engineers from nearly fifty countries all over the world. It was designed by H. Stubbins, architect of Cambridge, Mass., and Severud, Elstad and Krueger, structural engineers of New York.

The major goal of the Congress was to review progress in prestressing since the last Congress was held in Amsterdam in 1955. Papers were submitted and published early enough to be sent to all registrants several months before the Congress. Then discussions of these papers were prepared by Congress participants and presented orally at the various sessions. These papers and discussions were confined to three general areas:

Session 1. Developments in Design Methods

Session 2. Progress in Site Techniques

Session 3. Progress in the manufacture of factory-made precast, prestressed concrete units and in their use and assembly at the site.

A fourth session consisted of short papers on structures executed wholly or partly in prestressed concrete since the 1955 Congress and embodying important developments in design and construction. This latter session was of great value because it gave a quick birdseye view of a great many interesting structures.

Many features of the Congress were unusual from an American standpoint. The opening session, for example, was marked by a "musical opening" in which a quintet of reeds played Beethoven. Then followed short talks by politicians including the Lord Mayor of West Berlin, Dr. H. C. Brandt, and finally a principal speech on archeology. During the first part of these opening features one member from each nation present was seated on the dais behind one of the long tables with his name and national flag before him—reminiscent of the U. N. Security Council.

Every talk presented was simultaneously translated into all four official convention languages—French, English, German and Spanish. Every seat in the Congress Hall was equipped with an earphone and a dial so that any language could be heard.

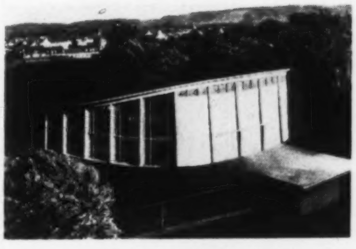
The Congress included a one-day tour of both West and East Berlin and visits to construction sites in West Berlin. On entering East Berlin we got a new guide, who handed us numerous books of Communist propaganda, including one pamphlet entitled "War-Mongers of West Berlin." Our East Berlin tour included a visit to the beautifully landscaped monument built by the Soviet Union to commemorate the soldiers killed by the Germans.

Developments in Design Methods

It is evident from the presentations at this Congress that prestressed concrete has "settled down" somewhat. The various problems of design are now being attacked carefully and slowly by many people in different countries, and there is beginning to be a good deal of agreement. A major exception is in the design for shear strength. Four papers carefully developed formulas for calculating shear strength, each one based on different empirical results. The radical divergence in the results, compared by H. Rüsch in Fig. 1, will surely deter the designer from taking liberties with shear.

Of the 24 papers on design, 9 were from Communist countries (USSR, Poland, Czechoslovakia, and Romania) whereas only one was from the U.S.A. None dealt

In Germany concrete bridges of 300-ft span are built without falsework by prestressed cantilever methods.



Exposition Hall in Black Forest, Germany, has doubly-curved post-tensioned thin-shell roof.

Half-mile viaduct in City of Brussels has winged beams prestressed longitudinally, and single row of supports.

with the question of shear. One contained a description of the building codes used in the USSR for prestressed concrete design. Their concept of safety factors is much more variable for differing building uses than ours.

Prof. André Paduart of Belgium continued a detailed comparison of all existing world codes begun at the 1955 Congress and gave the basis for an International Code for Prestressed Concrete. Many of his recommendations differ substantially from the recently published tentative recommendations for prestressed concrete published by the ASCE-ACI Joint Committee. Notable among the differences is the allowable initial steel stress of 90 percent of the ultimate breaking strength and considerably less cover of steel than we allow.

Progress in Site Techniques

The two major questions discussed during the session on site techniques were the friction of prestressing wires in ducts, and grouting of ducts after wires have been tensioned. Both these items are concerned with post-tensioning and hence are emphasized more in Europe than in the U.S.A. One of the most interesting facts learned at the Congress was that both the U. S. A. and the Soviet Union tend to take the same approach to their application of prestressing to concrete construction. Both emphasize pretensioned factory production much more than post-tensioned on-site construction. Hence, of the 17 papers concerning on-site techniques, none were from the U.S.A. or the Soviet Union.

Both Great Britain and the Netherlands presented comprehensive national reports about on-site techniques. This method of reporting was extremely valuable because it brought together the experiences of many engineers in one country in a concise report.

There still is some controversy on grouting post-tensioned wires in their ducts. There were no reports on the problems of structural damage after construction due to faulty grouting. The problem of faulty grouting during construction was discussed particularly in connection with possible damage from the freezing of water trapped in ducts. The value of aluminum powder in the grout was debated. The British report claimed that the expansion caused thereby compensates in advance for the shrinkage which takes place later in the grout. On the other hand the Dutch reported that this view is in error and concluded that no advantage results from the use of aluminum powder in closed ducts.

Over one-third of the papers in this session dealt with the effect of friction of wires in ducts during post-tensioning. Various equations and empirical data were presented in an effort to evaluate friction losses. The "wobble" effect was reemphasized, in which small deviations in a theoretically straight tendon cause substantially increased friction losses. One report stated that rolled steel wire leads to greater friction loss than drawn steel wire. Another stated that friction between steel and a concrete duct is greater than between steel and a steel-sheathed duct. The use of lead-coated sheaths and aluminum sheaths was mentioned in the British Report.

Design and site problems are universal but manufacturing and construction techniques vary considerably from country to country, being closely related to the economy.

Factory Techniques

One Soviet Union paper dealt with the factory production of beams, floor slabs and wall panels, all of standard design. The method of continuous prestressing used in the Soviet Union employs the "turntable" machine shown diagrammatically in Fig. 2. The wire is kept at constant tension while being wound around pins in a pan to form the patterns needed for beams, floor slabs or wall panels. After the pan is removed from the turntable, concrete is poured around the pretensioned wires to form the product. The plant cost for such production is high, admittedly justified only where huge numbers of standard units are to be produced, as is possible in the Soviet Union where the government sets and controls the demand for all production.

In Britain, where the economy is more like ours, practice still differs from ours in many ways. For pretensioning only wire of 5 mm and 7 mm is used and very little strand. Presumably this is because the material cost of strand is higher. Steam curing is not used on long-line pretensioning. Also in Britain more use is being made of rectangular hollow beams rather than I-section beams. A method of forming the voids by wrapping paper around pretensioned wires helps make these sections economical.

Harold Price, M. ASCE, of the U.S.A., mentioned a little-publicized prestressing factory in California where three shifts are employed, each highly specialized in one phase of post-tensioning. This was

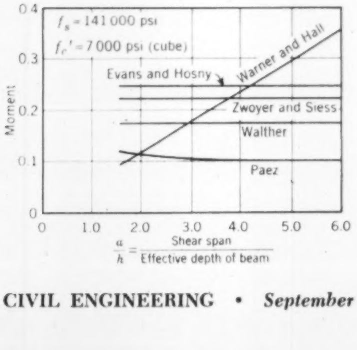


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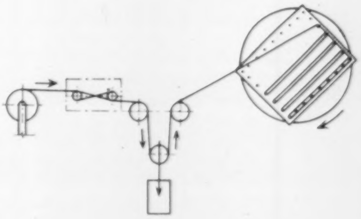
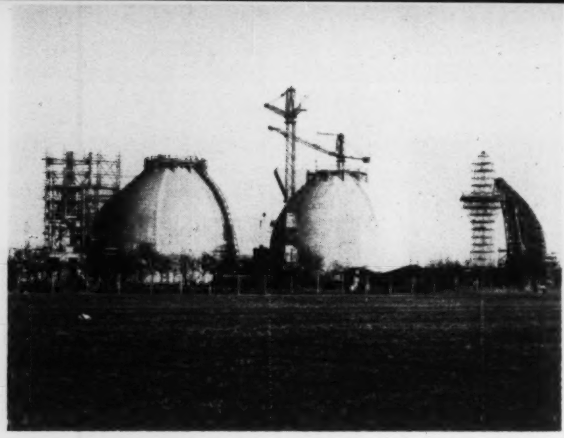
FIG. 1. Proposed formulas for calculating shear strength show radical differences.

►

FIG. 2. Continuous pretensioning turntable and casting pan are of type used in Russia.

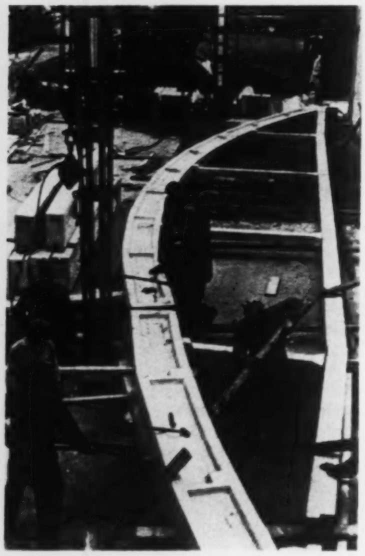




These doubly-curved, prestressed-concrete, sewage-sludge tanks in Frankfurt-am-Main, Germany, are similar to those in Berlin included in a Congress tour.

Above, right, prestressed-concrete footbridge at Brussels World's Fair will later be used as a highway bridge at another site.

Precast elements are being assembled for 72 ft prestressed arches for factory in Beverwijk, Holland.



the only mention of factory post-tensioning in the entire Congress.

Another use of post-tensioning is in the "wafer-slab" construction in Britain, described by Dr. Paul W. Abeles, M. ASCE, and shown in Fig. 3. By this method heavily loaded highway bridges over railways are made wafer-thin with depths down to $L/30$. Precast beams with large bottom flanges are pretensioned to 3,000 psi. Three or four such beams are placed side by side and concrete is cast in place over them with post-tensioning ducts built in. After most of the losses due to creep and shrinkage have taken place, the composite slab is post-tensioned so that the precast pieces are again stressed to 3,000 psi. Large live loads can be carried even when the cast concrete is in high tension because the prestressed bottom flanges of the precast beams will still be in compression. Excellent lateral distribution of loads is obtained without transverse prestressing.

A national report by the Dutch discussed the difficult problem of connections in precast concrete and particularly methods of obtaining continuity. One ingenious method already applied in Holland (recently used for the first time in the U.S.A. in the design of the Lake Oneida Bridge in New York State) is the use of transverse prestressing to obtain continuity. The specially prepared ends of the precast girders are lapped past each other at the zero point of bending moment and are tied together with transverse prestressed wire to provide continuity across the joint. The main advantage lies in the ability to create long spans out of precast pieces without complex connections.

The Dutch report also gave as typical an example of prefabrication and pretensioning using small precast units to make up the arched roof trusses for a factory in Beverwijk, Holland. The roof of this structure is supported by 12 prestressed two-hinged arches, each spanning 72 ft. The elements of these arches, including tie-beams and suspenders, were factory made, transported to the site, and assembled on a flat floor where the joints were filled with mortar and the cables drawn through the members and tensioned. Two masts were used to lift the completed arches into place. The 14-ft space between arches was spanned by concrete purlins, on which the lightweight precast slabs were placed.

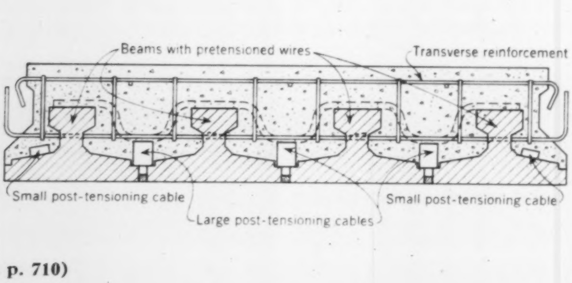
Long-Span Trusses

Creation of long spans for buildings has been one of the most interesting features of prestressed concrete. A logical and seemingly economical system is the prestressed concrete truss. So many examples of this system were given at the Congress that I conclude it is already considered a practical solution in many places.

One striking example of long spans framed by prestressed trusses is a truss roof made from small precast units described in a British national report and shown in an accompanying photograph. A hangar at Gatwick Airport is roofed by a series of triangulated space frames making up the secondary beams and spanning 105 ft. Each beam is a three-dimensional truss supported at the back of the hangar on columns 20 ft on centers and at the front on temporary scaffolding during construction. Each truss is an assembly of small precast members connected on the ground by longitudinal and vertical prestressing. The main truss, which supports the secondary trusses at the front of the hangar, is continuous over two 140-ft spans, and is formed by precast sections placed between the ends of the secondary trusses. After the main beams were tied together with post-tensioning cables, the temporary supports were removed. The purlins between secondary trusses are also post-tensioned together. The total weight of the roof concrete is only 22 lb per sq ft of floor area.

Additional uses of trusses were described in reports from Poland, Romania, and the Soviet Union. The Polish paper describes a series of trusses standardized for various spans and made up generally of small precast units which are con-

FIG. 3. "Wafer" slab for railroad bridge deck is used in Britain for spans of over 60 ft.


Beams with pretensioned wires
Transverse reinforcement
Small post-tensioning cable
Large post-tensioning cables
Small post-tensioning cable

nected and prestressed together on the ground. Some of the types are shown in Fig. 4. Most interesting are the trusses of 120-ft span which are lifted into place between double columns by hand winches much as has been done for long prestressed girders in Belgium, Canada and the U.S.A. The reports of engineering in Communist countries included little discussion of cost comparisons or preliminary studies. They gave little attention to design and research but more to actual construction.

An unusual system of prestressing called the Preflex Beam has been developed in Belgium by A. Lipski, and some examples were shown at the Congress by M. Rogier Fougnies. The system consists simply of a steel wide-flange beam. Before erection the beam is given a deflection by means of heavy loads. While held in the loaded position, concrete is cast around the bottom flange for the span of the beam except for a few inches at each end for connections. Once the concrete has acquired design strength, the loads are released. The beam then attempts to return to its original position, and as it does so the bottom part tends to shorten and hence transfers compression to the concrete. The top part of the beam is then encased in concrete. Thus it is possible to have a fire-proofed steel beam in which all the enclosing concrete is in compression and all contributes to the strength. See Fig. 5.

Structures Executed Since 1955

Reports on structures built since 1955 were heard from 24 countries in two sessions of nearly three hours each. The chairman of one session was G. K. Yevgrafov of the Soviet Union; the chairman of the other was Prof. T. Y. Lin, M. ASCE, of the United States. Time restrictions were rigidly followed so that only rapid, concise descriptions were possible. Over half of the projects described were bridges. Many interesting and valuable developments and innovations were displayed. It was obvious that in many countries prestressing is so common now that there is much similarity between projects. A few highly unusual presentations demonstrated the remarkable possibilites of prestressed concrete.

In the town of Orebro (Pennybridge), Sweden, the city fathers decided that the community needed a 1¼-million-gal water tower, and since it was to be in a central location they wanted an esthetic as well as a utilitarian design. Constructed in prestressed concrete, the 223-ft-high tower is shaped like a huge and graceful champagne glass, the bowl 150 ft across, the hollow stem 35 ft in diameter. The project was described by Kurt Erikkson of Stockholm, who is also one of the designers. (An article on the design and construction of this water tower will appear in the October issue of Civil Engineering.) The bowl was cast on the ground around the stem and jacked up as the cylindrical stem was poured at the rate of 2 ft per day. The finished tower has a restaurant on top, serviced by two elevators inside the stem, and the tower houses radio and TV facilities. The tower was completed recently.

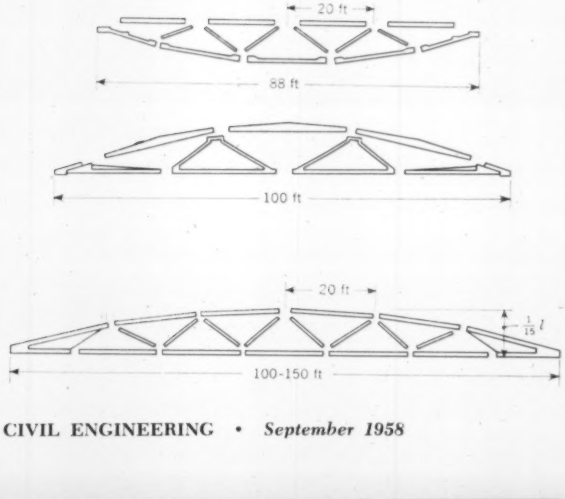
At the International Fair in Brussels, prestressed concrete has also found a place. M. Rogier Foungies presented some interesting Belgian structures including a long footbridge through the middle of the Fair, overlooking the pavilion of the United States and that of the USSR. In the main frame, both girders and columns are of hollow-box cross section and post-tensioned. The stringers, of a standard precast, pretensioned section used frequently in Belgium, are designed for highway loading. After the Fair is over they will be removed and reused in an actual highway bridge. Partly in connection with the Fair, the City of Brussels has undergone a good deal of reconstruction recently. One project of note is a half-mile viaduct built like a butterfly roof with only a single row of supports in the center to avoid traffic obstructions on the street below. The winged beams are prestressed longitudinally.

One of the most renowned concrete designers and builders in the world is the German firm of Dyckerhoff and Widmann, which began to build prestressed bridges in the 1920's under the designing leadership of Franz Dischinger and Ulrich Finsterwalder. Dr. Finsterwalder presented some recent projects of his firm which are magnificent examples of imaginative uses of concrete in conjunction with the technique of prestressing.

Long-span bridges are built by the cantilever method, in which construction is begun from opposite supports and built in stages toward the center of the span. Each stage is cast on a cantilevered form and after curing is post-tensioned to the completed work. When the two cantilevers meet, they are joined, and further post-tensioning creates a continuous flat arch of shallow section at the center and a deeper section over the supports. A graceful long-span concrete structure is obtained without costly scaffolding and, where over water, with no interruption to shipping. A bridge of 300-ft span constructed by this method was visited by Congress participants during one day of field visits.

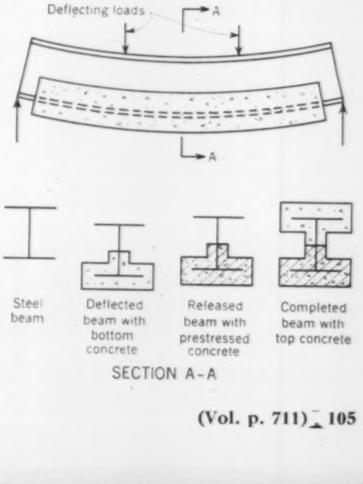
The second example visited, one of the most interesting sites seen in Berlin, consisted of tanks for a sewage purification plant. This site contained 8 prestressed concrete sludge tanks on an area formerly occupied by a racecourse. Maximum diameters are about 70 ft and the heights are about 110 ft, of which about 100 ft is above the ground. The tanks have a doubly curved shape which has the maximum diameter at about mid-height and the smaller diameter at the top and at the base. See an accompanying photograph. This type of construction not only gives a double curve which is economical from the standpoint of materials but also has an advantage in terms of the sludge sedimentation itself.

At the time this site was visited, one of the tanks was being cast and another was being formed. The forming is done by segments, about six segments per tank. Since there are eight tanks, the forms



←

FIG. 4. Prestressed concrete trusses are typical of those produced in Poland.


Deflecting loads
A
A
Steel beam
Deflected beam with bottom concrete
Released beam with prestressed concrete
Completed beam with top concrete
SECTION A-A

→

FIG. 5. In Belgian method, steel I-beams are prestressed for building construction.

will be reused many times. The reinforcing patterns were so complicated that the reinforcing elements were assembled in molds on the ground and the entire reinforcing cage then lifted into place. The tanks are prestressed by the Dyckerhoff-Widmann system.

The third example of outstanding design and construction visited was the hanging shell for the Black Forest Exposition Hall. Here a ring of concrete is cast and a thin doubly-curved shell of concrete cast between, with sheathed high-tension bars throughout. Once the shell has cured, the bars are stressed and the entire shell becomes post-tensioned. This is not a prestressed draped cable roof like that of the Berlin Congress Hall, but rather a monolithic shell, hence the supporting ring need not be so prominent.

In this connection the Congress Hall itself is a monument to prestressed concrete. Its design, using inclined arches with the roof between supported by suspended cables, is similar to that of the pavilion in Raleigh, N. C. (See CIVIL ENGINEERING for March 1954, p. 52.)

Located in West Berlin, only a five-minute walk from the boundary of East Berlin, the Congress Hall was an appropriate center for an international meeting. During the week an American could talk with engineers from Communist countries as well as with other Europeans, Africans, and Asians. At one point the Congress was favored with a surprise visit by John Foster Dulles.

Amid the ruins of old Berlin the West Germans are building again. If there was any unofficial theme for this Congress it surely was that civil engineers desire to construct and not to destroy.

N*G*Neare's COLUMN

R. Robinson Rowe, M. ASCE

"Glad to see you back from your vacation, Joe. Hope your rest wasn't spoiled by our least squares problem. The committee on Boroughs and Wards is waiting to hear how you divided Esseyeville's 41078 souls into 19 nearly equal wards and then grouped the wards into four nearly equal boroughs. You had plenty of time, of course."

"Sure did, Professor, but I fished," said Joe Kerr.

"And forgot the problem?"

"Not quite. I caught 19 perch. My wife and the two little Kerrs each got five and I ate only four. When you divide 19 by four, someone always gets the short end, usually me. If Cal can do better, I'd like to watch."

"Then look first at the right answer," boasted Cal Klater, "before I explain.

WARD	PEOPLE	IDEAL	ERROR
1	6348	6486	−138
2	$x =$ 2024	2162	−138
3	2024	2162	−138
	10396	10269½	+126½
4	$y =$ 2484	2162	+322
5	2484	2162	+322
6	2484	2162	+322
10	2484	2162	+322
	9936	10269½	−333½
7	$z =$ 2070	2162	−92
8	2070	2162	−92
9	2070	2161	−92
14	2070	2162	−92
16	2070	2162	−92
	10350	10269½	+80½
11	6348	6486	−138
12	2024	2162	−138
15	2024	2162	−138
	10396	10269½	+126½

"The second column is the answer, the third column the pro rata population, and the last column the deviations. All can be expressed in terms of the numbers designated as x, y and z if we first derive $10{,}396 = 4{,}324 + 3x$. Then, since the total population is $41{,}078 = 2(4324 + 3x) + 4y + 5z$, we have

$$z = 6{,}4786 - 1.2\,x - 0.8\,y \ldots\ldots (1)$$

"We must minimize the sum of the squares of the deviations:

$$S = 6(2162 - x)^2 + 4(2162 - y)^2 + 5(2162 - z)^2 + 2(5{,}945\tfrac{1}{2} - 3x)^2 + (10{,}269\tfrac{1}{2} - 4y)^2 + (10{,}269\tfrac{1}{2} - 5z)^2.$$

Expanding and substituting (1) to eliminate z:

$$S = 67.2\,x^2 + 57.6xy + 39.2y^2 - 415104x - 311328y + C \ldots (2)$$

$$D_xS = 134.4x + 57.6y - 415{,}104 = 0 \ldots\ldots (3a)$$

$$D_yS = 57.6x + 78.4y - 311{,}328 = 0 \ldots\ldots (3b)$$

"I solved Eqs. 3 simultaneously to find the answers already given. Then everybody lives in a small ward of a large borough, or vice versa, satisfying proportional representation scientifically."

"But which," mused the Professor, "may leave the bewildered Committee bewildereder. Perhaps they'll get smart and add a Ward 13 to Borough II, so as to have 20 aldermen in 4 boroughs and no excuse for gerrymandering.

"I have another interesting example of nearly equal division. The Roman geometer, Quintus, died, leaving to his three sons a level tract of land in the shape of a regular pentagon. His will directed his eldest son, Antiguus, to fence off for his younger brethren the largest possible square. The second son, Brutus, in turn, when Cassius came of age, was to fence off for him the largest regular triangle that could be described in the square. How equitable was Quintus?"

[Cal Klaters were Sauer Doe (Marvin Larson) and Ed C. Holt, Jr. Any resemblance of wards and boroughs to districts and zones was not intended to be other than a purposeful coincidence. Also acknowledged are correct solutions to recent problems from Ulrich W. Stoll and Elmer W. Gable.]

Civil Works Authorizations Listed by Army Engineers

New Congressional authorizations for the Civil Works Program of the Army's Corps of Engineers include 139 individual projects in 44 states, Alaska, Hawaii and Puerto Rico. Total expenditure authorizations for twelve river basins are also increased.

The total estimated federal cost of work authorized in the bill is $1,556,230,500, of which $1,356,230,500 is for the Corps of Engineers and $200,000,000 for Missouri River Basin work by the Department of the Interior. Allocations are as follows:

PROJECTS	TYPES OF PROJECTS	ESTIMATED COST
68	Flood control	$ 545,579,800
12	Basin authorizations	608,300,000
57	Rivers and harbors	190,723,000
14	Beach erosion control	11,627,700
151		1,356,230,500
1	Dept. of the Interior	200,000,000
152		$1,556,230,500

There are also authorizations for 61 surveys, in 27 states and Hawaii.

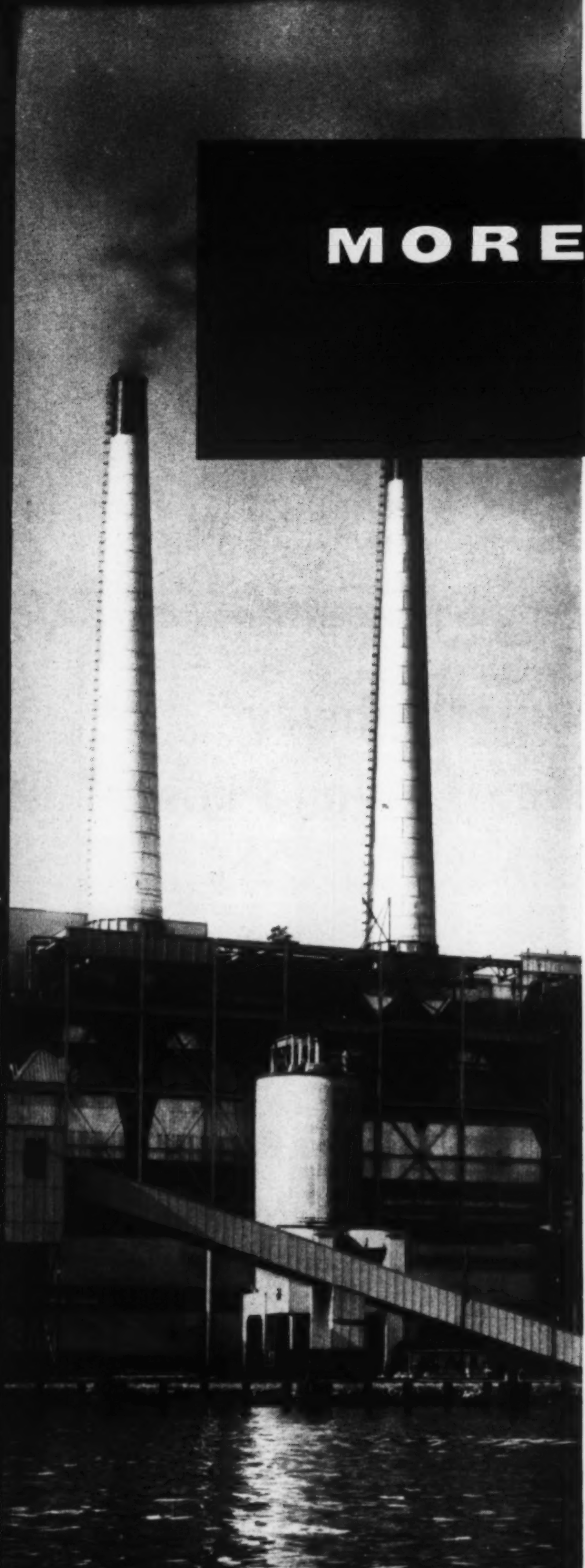
This is the first omnibus river and harbor and flood control authorization bill since 1954. Actual work on the projects will not be undertaken until funds are provided by the Congress.

Billion Dollars to Be Spent on Canadian Roads

The Canadian Good Roads Association estimates that during the current year all governments—federal, provincial and municipal—will spend a total of $1,044 million on road construction, maintenance and administration.

The new record high represents an increase of 7 per cent over estimated expenditures of $979.6 million during 1957-1958.

Provincial governments will be responsible for the expenditure of $669 million, municipal governments for $260 million, and $116 million will be spent by the federal government.



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Railroad jumps superhighway on USS Steel H-Beam Bearing Piles

They do things in a big way in Chicago. This maze of USS H-Beam Bearing Piles will soon carry four main tracks of a major railway over a temporary trestle spanning the new Northwest Route Expressway. Thus, traffic can flow on the railroad while the new overpass is being built.

This is an excellent example showing the versatility and strength of steel bearing piles. In this case, the piles are doing double duty. They serve as end bearing piles supporting the dead load of the temporary structural steel trestle, and, in addition, they serve as structural column bents wherein they must resist the heavy loads caused by moving trains, such as bending, sway, and thrust.

In addition to their great strength and rigidity, the value of steel bearing piles is further enhanced by the speed and ease of installation and the minimum amount of fabrication required to complete the trestle. A total of 2,410 tons of Steel H-Beam Piles were used in lengths from 45′ to 98′ and weights from 73 to 127 pounds per foot. As an example, the 95′ piles were driven about 65′ into the ground at a rate of 18 to 20 per 8-hour day.

When the excavation is completed, the piles will protrude about 45′. This is another reason for the choice of steel bearing piles. Any other pile as a substitute would expand the congestion problem and make excavation very difficult. In order to equal the strength and rigidity of steel, other types of piles would of necessity have to be more numerous and intricately braced.

For information on the use of USS H-Beam Bearing Piles, write for our free book. United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

The Project

Interstate Route No. 2, Northwest Route Expressway. Railway grade separation. Temporary Trestle. W. Kinzie St. to W. Hallard St. **Owner:** City of Chicago, Dept. of Public Works, Bureau of Engineering. **General Contractor:** W. E. O'Neil Construction Co., Chicago, Ill. **Sub-Contractor, Pile Driving:** Fitz Simons & Connell Dredge & Dock Division of Merritt-Chapman & Scott Corp., Chicago, Ill. **Participating Agencies:** Bureau of Public Roads, Cook County Highway Dept., State of Illinois Division of Highways.

USS Steel H-Beam Bearing Piles to support four main tracks of a major railway on temporary trestle. Steel supplied necessary strength without bulk. ▶

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News of Engineers

(*Continued from page 27*)

Marvin L. Granstrom has taken the position of chairman of the Department of Civil Engineering at Rutgers University. Professor Granstrom was formerly an associate professor of sanitary engineering at the University of North Carolina. **W. B. Snow,** who has served as chairman of the department at Rutgers, will remain on the staff. At the University of North Carolina, **D. A. Okun** is head of the Department of Sanitary Engineering. This notice will correct an incorrect one printed in the August issue on page 24.

Carlos G. Bell, Jr., associate professor of civil engineering at Northwestern University, will spend the coming academic year in specialized study of nuclear reactors at the Oak Ridge National Laboratory. Professor Bell, who has been with the university for four years, has conducted research under Atomic Energy Commission contract in the field of radioactive wastes.

Charles T. Looney has been named head of the civil engineering department at the University of Maryland. Before his appointment, Dr. Looney was associate professor and director of graduate studies in engineering at Yale University. He is the author of several Proceedings papers and of bulletins prepared for the University of Illinois Engineering Experiment Station. In 1944 he received the Naval Ordnance Award for important wartime research.

Dr. C. Looney

Five ASCE members are among the new officers elected by the National Society of Professional Engineers. **Dr. Clark A. Dunn,** professor of civil engineering and executive director of engineering research at Oklahoma State University, has been named to the presidency. Regional vice presidents include **John B. McGaughy,** Norfolk, Va., Southeastern Region; **W. L. Hindermann,** St. Paul, Minn., North Central Region; **L. R. Durkee,** Seattle, Wash., Western Region; and **Noah E. Hull,** Houston, Tex., Southwestern Region.

Glenn H. Phillips and D. A. Young have recently formed the partnership firm of Phillips and Young, architects and engineers. The office will be located in Suite 22, Wynnewood Professional Building, Wynnewood Village, Dallas 24, Tex. Mr. Phillips has been with Grayson Gill, architect and engineer, in Dallas, as a structural engineer.

Charles H. Topping has been unanimously reelected as president of the Building Research Institute. Mr. Topping is senior architectural and civil consultant with the E. I. duPont de Nemours and Company, Inc., in Wilmington, Del.

Paul F. Rice has joined the staff of the Concrete Reinforcing Steel Institute in Chicago as assistant to the managing director. In his new capacity, Mr. Rice will handle field and office work in the promotion and technical aspects of the use of reinforcing steel. Since 1954 he has been technical director of the American Concrete Institute.

P. F. Rice

Ven Te Chow, professor of hydraulic engineering at the University of Illinois, is making a round-the-world tour. Professor Chow has been asked to lecture and to act as consultant in many different parts of the world. He will visit England, France, Belgium, Austria, Turkey, India, Thailand, Japan and the Hawaiian Islands. In Japan at the Regional Convention of the Japan Society of Civil Engineers, Professor Chow will speak on "Trends in Hydraulic Engineering Education and Research."

C. H. Gronquist was honored by his alma mater, Rutgers University, with the honorary degree of Doctor of Science at commencement exercises this past June. The degree was conferred in recognition of Mr. Gronquist's work on the design and supervision of the construction of many major bridges in the United States. Mr. Gronquist is an associate engineer with D. B. Steinman, consulting engineer of New York City.

Edward W. Thorson has been appointed regional manager-district engineer with the Portland Cement Association. In this position, Mr. Thorson will supervise district offices in Salt Lake City, Utah, and Helena, Mont., and the newly opened district office in Denver, Colo. Mr. Thorson has been with the Association since 1934, taking leave of absence for a four-and-a-half-year tour of duty as a naval officer in World War II.

H. B. Leaver, J. H. Boynton, and W. H. Lenox have all been promoted recently in the sales staff of Armco Drainage and Metal Products, Inc., at Topeka, Kans. Mr. Leaver has been named sales manager for the Midwestern Division, which includes Kansas, Missouri, Iowa and Nebraska. Mr. Boynton will succeed Mr. Leaver as state sales manager for Kansas and Missouri, and Mr. Lenox will take over the position of sales engineer for the Wichita area.

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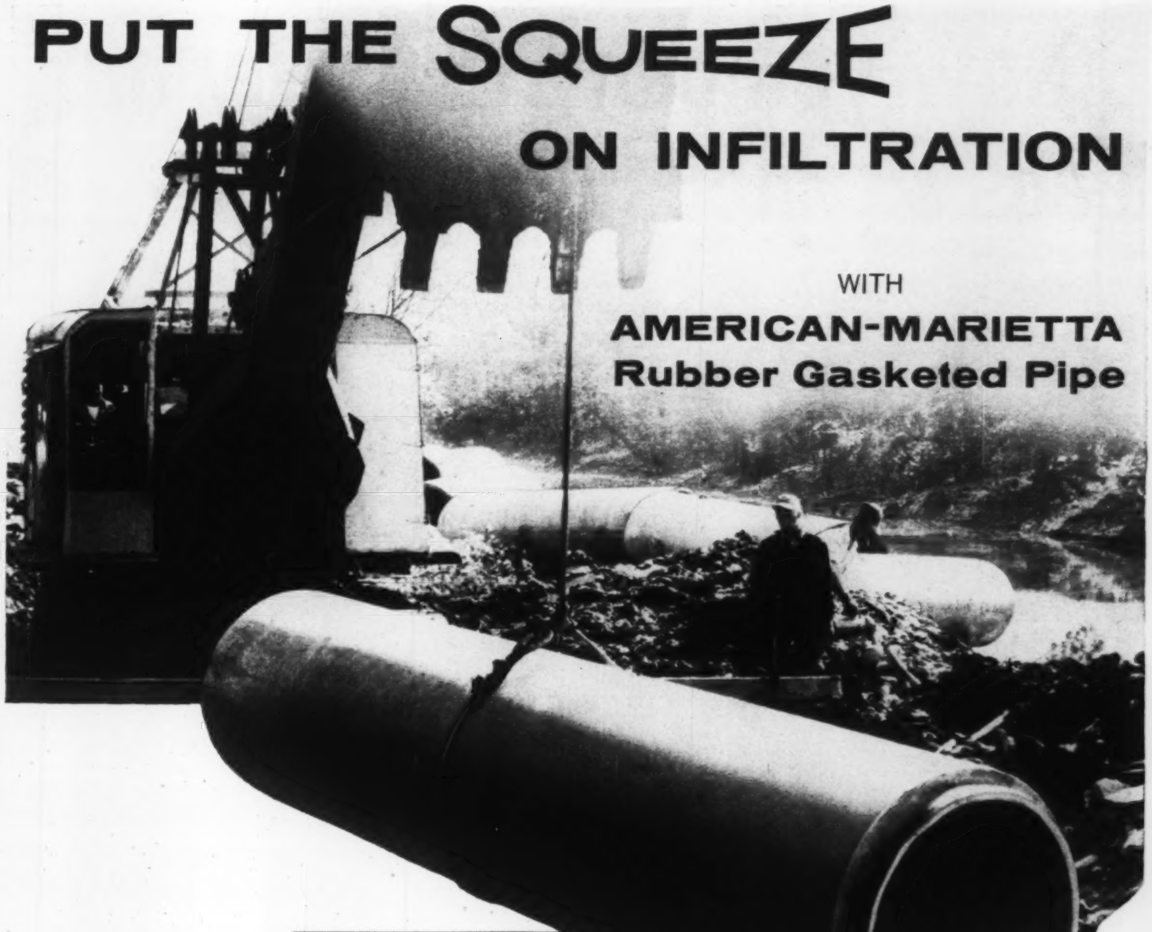

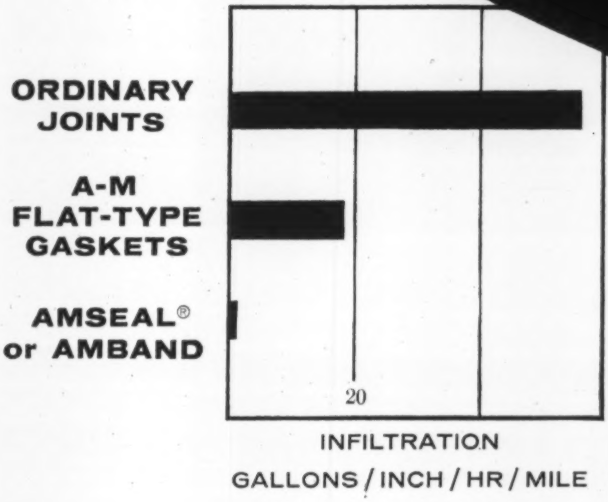

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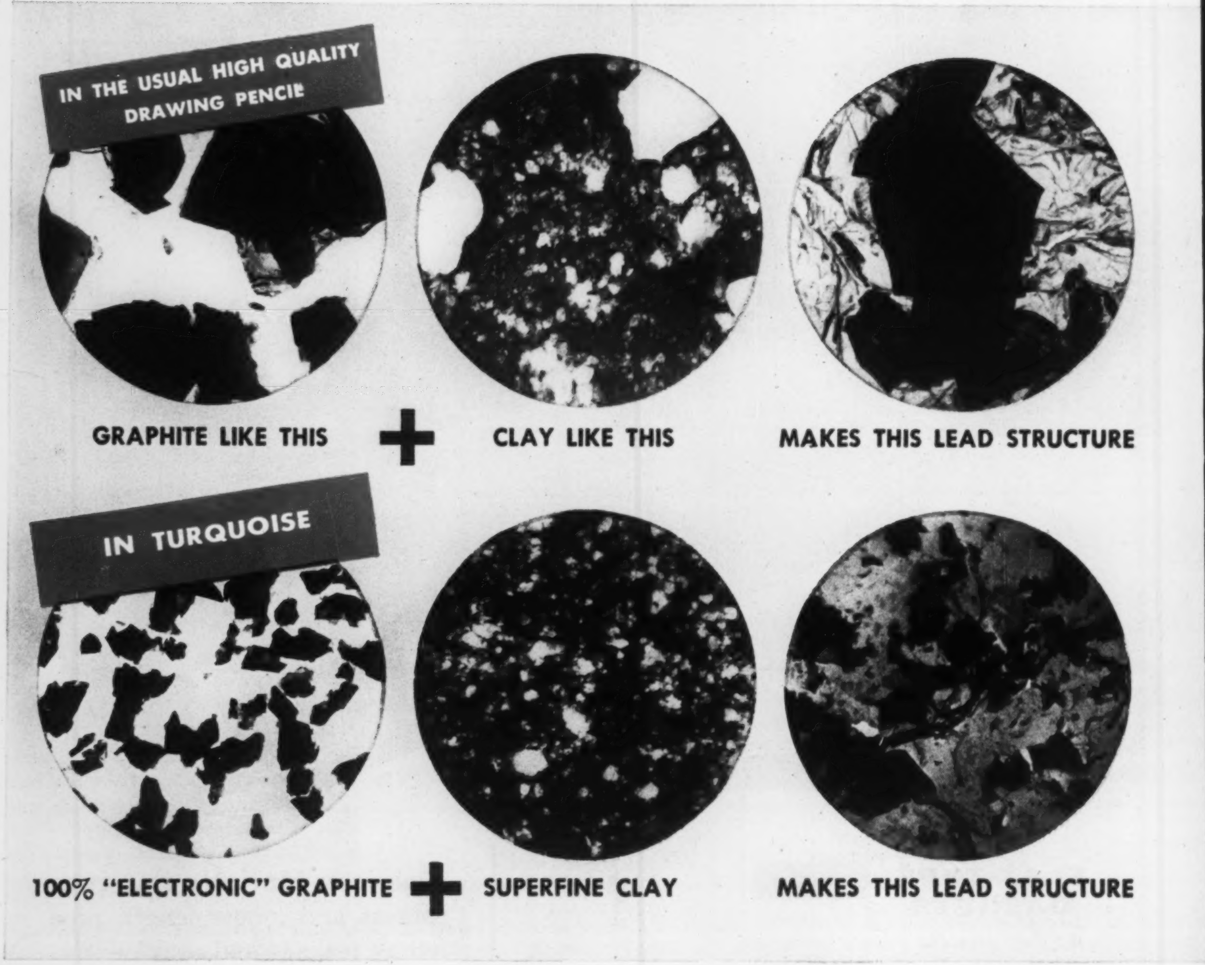
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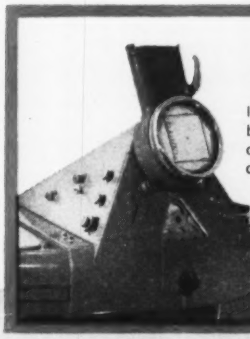

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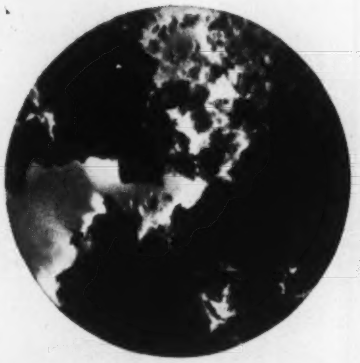

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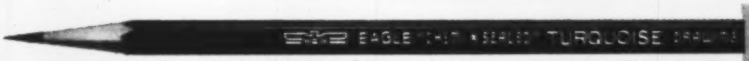

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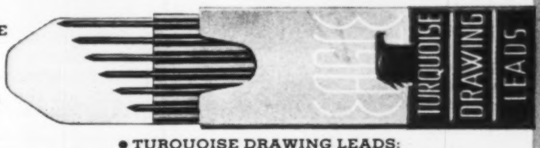

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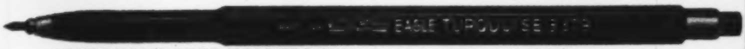

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DECEASED

Guy M. Bassel (M. '17), age 91, civil engineer of Maryville, Tenn., died there on July 19. He had been in private engineering practice for many years. After graduating from Peabody College of the University of Nashville, Mr. Bassel served as construction engineer on the erection of the Aluminum Company of America's reduction plant in Alcoa, Tenn. With Alcoa, he also did engineering work for the construction of Unit Two of the Alcoa Steel Mill.

Henry C. Dinney (M. '56), age 63, consulting engineer with the Second Gotham Corporation in New York City, died in Forest Hills, N. Y., on May 29. A graduate of Cooper Union, Mr. Dinney served as consultant on many major buildings in New York City and Long Island.

Starks C. Dougherty (A.M. '28), age 65, resident engineer with the Texas State Highway Department, Midland, Tex., died there on March 4. Mr. Dougherty had been with the Highway Department since 1928. He had been on leave of absence as a private consultant and later as paving engineer at Camp Berkley in Abilene, Tex.

Charles T. duRell (M. '38), age 86, retired mining engineer, died in Pomona, Calif., on February 27. A graduate of the Colorado School of Mines, Mr. duRell spent most of his career with gold-mining concerns in this country and in South Africa, Australia and the Philippines. Mr. duRell was in charge of one of the first depreciation studies ever made for industry. The data gathered determined the useful life of important depreciable items in various industries. The results of the study were published by the Treasury Department.

P. M. Feltham (M. '08), age 78, retired captain in the U. S. Corps of Engineers, died on May 22 in Augusta, Ga. A native of England, Captain Feltham came to the United States when he was twelve. He was graduated from Porter Military Academy in Charleston, S. C. During his early career, he was resident engineer on the construction of the Olympia Cotton Mills, at that time the largest cotton plant under one roof in the world. Captain Feltham had been with the Corps since World War I. He was founder and former national commander of Disabled Emergency Officers of World War I and promoted legislation for retirement of these officers enacted during the Harding administration.

(Continued on page 118)

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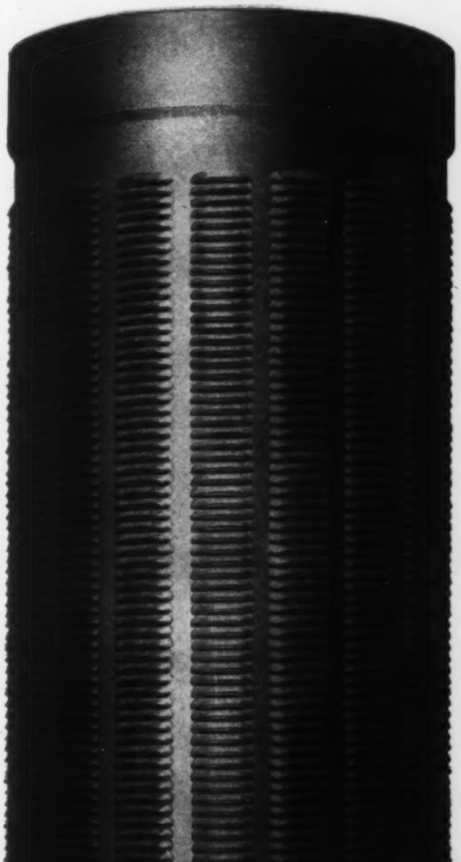

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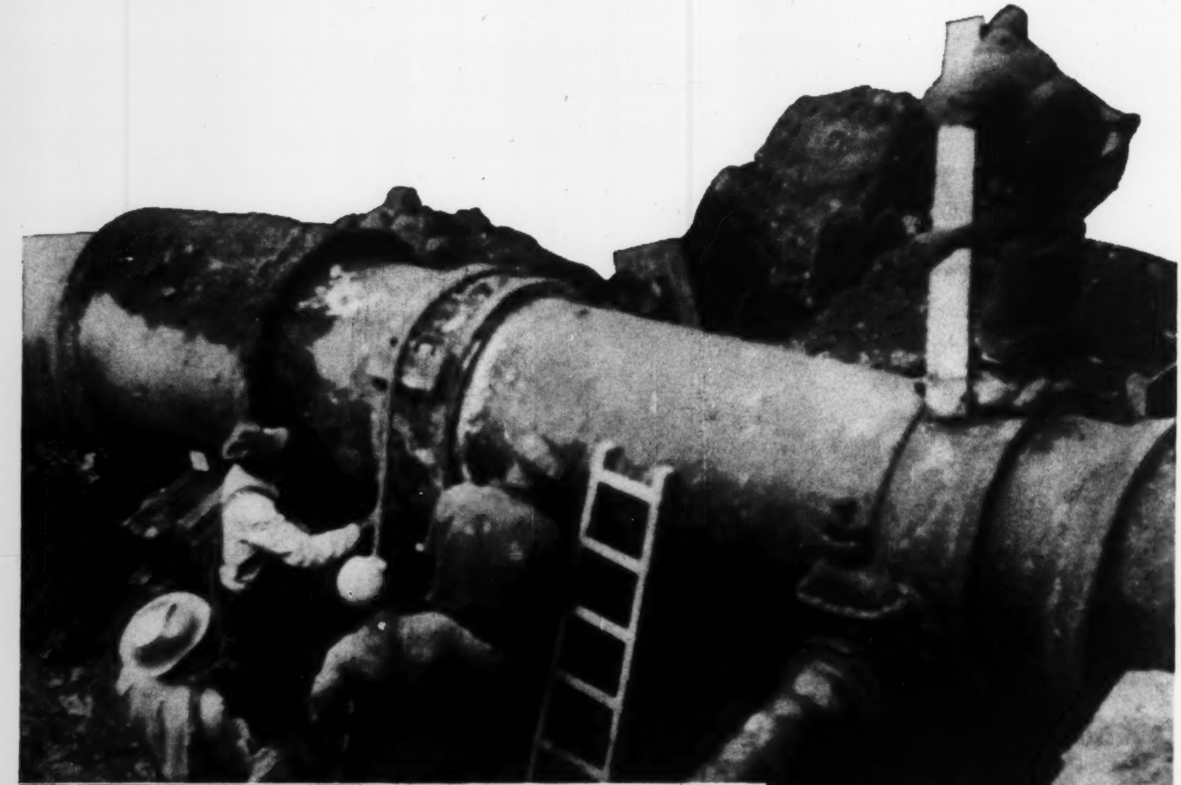

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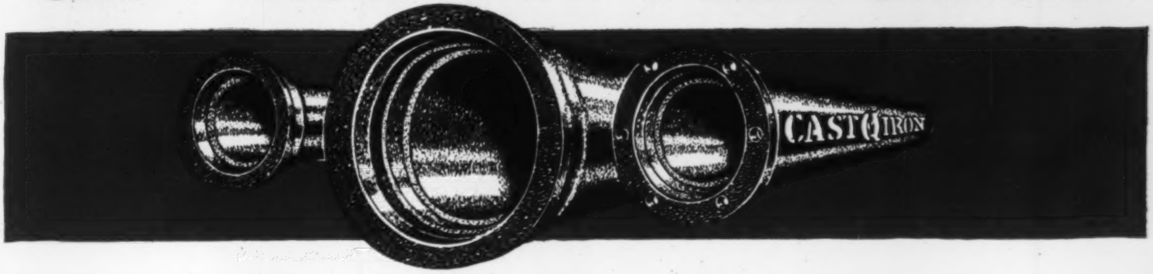

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pipe FOR MODERN WATER WORKS

Deceased

(Continued from page 114)

Cornelius C. Freeborn, Jr. (A.M. '28), age 66, civil engineer and surveyor of Dumont, N. J., died there on July 5. Mr. Freeborn, who studied at Ohio Northern University, had been in private practice for over thirty years, mostly in the New York and New Jersey metropolitan area. He gained early engineering experience on the Hudson River Vehicular Tunnel and on construction of the Long Island Motor Parkway.

Jacob A. Harman (M. '12), age 92, retired engineer of Peoria, Ill., died there on July 10. A civil engineering graduate of the National Normal University in Lebanon, Ohio, Mr. Harman early became assistant engineer on the construction of the Peoria water works and later city engineer of Peoria. Mr. Harman started his private practice in 1895, specializing in sewage, drainage, and reclamation work, and retired in 1951.

Leo A. Hoynck (A.M. '13), age 75, engineer with the Bemis Brothers Bag Company in St. Louis, Mo., since 1919, died there recently. He was a member of the American Bar Association. His early experience included work with the St. Louis Department of Bridges and Buildings as a designer. He also designed steel barges and low boats for the Mississippi River Commission.

Orlando W. Irvin (A.M. '11), age 76, president of the Rail Steel Bar Association, Chicago, Ill., died in Bangor, Me., on July 26. Mr. Irwin studied at Wooster College and received his civil engineering degree from the Case Institute of Technology. He had been a civil engineer with the Truscon Steel Corporation for more than 20 years. For several years he was engaged in engineering work with the Carnegie Illinois Steel Corporation. He had been president of the Rail Steel Bar Association for over ten years. A founder and president of the Steel Joint Institute, Mr. Irwin's principal interests were structural engineering and the advancement of reinforced concrete.

Paul J. Marbach (J.M. '55), age 24, Lieutenant in the U. S. Navy, was killed in an airplane crash on May 27. Lieutenant Marbach had been in the Navy since his graduation from the University of Notre Dame in 1955. His home was in White Plains, N. Y.

John R. McCrone, Jr. (A.M. '36), age 55, partner in J. R. McCrone, Jr., Incorporated, surveyors and engineers of Annapolis, Md., died there on June 30. Mr. McCrone was graduated from the Baltimore Polytechnic Institute, and early served as city engineer of Havre de Grace, completing a Works Progress Administration project there. In 1937 he started his own firm in Annapolis.

Theodore S. Needels (M. '25), age 65, estimator with the Austin Company in Cleveland, Ohio, died in Houston, Tex., on May 18. A graduate of Ohio State University, Mr. Needels served in the Corps of Engineers during World War I. He had been with the Austin Company as engineer of design and estimates and as structural engineer. At one time he was with the King Bridge Company in Cleveland.

Allison C. Neff (M. '56), age 55, vice president of Armco Drainage and Metal Products, Inc., in Middletown, Ohio, died there on August 11. Mr. Neff was graduated from the Case Institute of Technology with a degree in mechanical engineering. For almost twenty years, he was with the Ohio Corrugated Culvert Company as sales engineer and Cleveland district manager. He had been with Arm-

(Continued on page 120)

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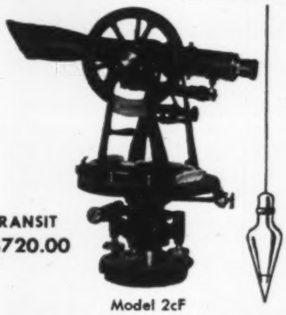

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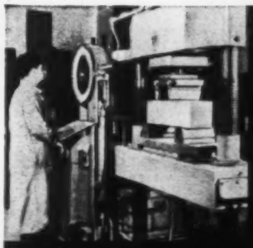

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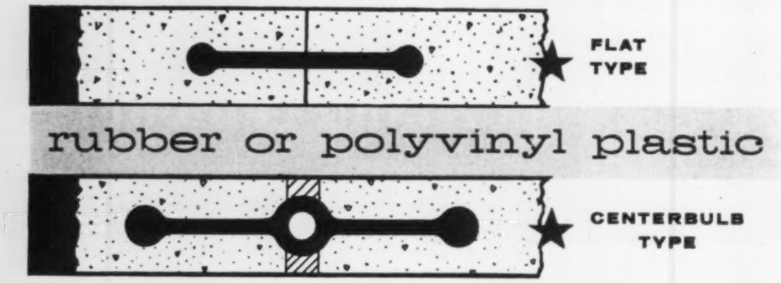

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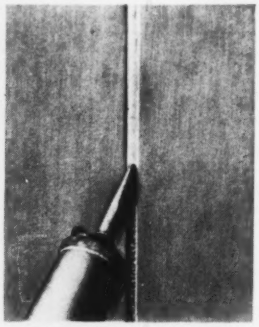

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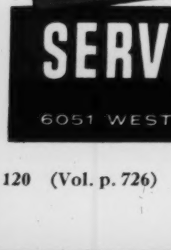

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Deceased

(*Continued from page 118*)

co since 1944 and had served as vice president since 1945. Active in engineering circles, Mr. Neff had served as director and more recently president of the National Society of Professional Engineers.

Frank D. Rideout (M. '31), age 78, consulting engineer for the Osborn Engineering Company, of Cleveland, Ohio, died there on July 8. Mr. Rideout was graduated from the engineering school at Purdue University. For more than 40 years he was contracting engineer with the American Bridge Division of the U. S. Steel Corporation. At the time of his retirement in 1954, he had been with the Osborn Company for seven years.

Blair Ripley (M. '13), age 77, retired Canadian engineer, died in Victoria, B. C., on July 5. A native of Nova Scotia, Mr. Ripley had been in charge of the location, construction, and grade revision of the St. Mary's Railway. He had also been in charge of the field work on the Lethbridge Viaduct and later on the Old Man's River and Outlook Viaduct. For his service in World War I as a lieutenant colonel commanding a Canadian railway construction battalion in France and Belgium, Mr. Ripley was awarded the Distinguished Service Order of the British Army.

Harvey Schermerhorn (M. '33), age 79, former acting chief engineer for the New York State Department of Public Works, died in Clearwater, Fla., on July 1. A civil engineering graduate of Rensselaer Polytechnic Institute, Mr. Schermerhorn's career consisted entirely of work for New York State. He was with the Department of Public Works as state engineer, the Highway Commission as division engineer, and the Bridge Authority as deputy chief engineer. In 1939 he was appointed Commissioner of Highways. At the time of his retirement, after 45 years of service, Mr. Schermerhorn was consulting engineer for the Department of Public Works.

Frederick Williams (M. '27), age 73, founder and retired president of the Standard Blueprinting Company of East Orange, N. J., died recently in Woodstock, Vt. From 1906 to 1918, Mr. Williams served with the Corps of Engineers. He was assigned to West Point, where he planned many of the buildings. He was the designer of the ten-inch gun emplacements and fire-control stations for East Coast harbors. Mr. Williams founded the Standard Blueprinting Company in the nineteen-twenties.

Mr. Oliver Osborne has his ear to the ground

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RECENT BOOKS

(added to the Engineering Societies Library)

Bemessungsverfahren

Sixteenth Edition revised by Helmut Löser.

Benno Löser presents a manual of design procedures which are in accordance with the specifications and codes of the German Committee on Reinforced Concrete. It covers exterior forces on structures, bending, torsion, shear stresses, bond stresses, materials, flat slabs, special reinforcements, and various special cases such as roof slabs with glass inserts. The text is preceded by a list of the pertinent German (DIN) standards. (1958, Wilhelm, Ernst & Sohn, Berlin, Germany. 351 pp., 22DM.)

Biological Treatment Of Sewage And Industrial Wastes

Volume II: Anaerobic Digestion and Solids-Liquid Separation.

Joseph McCabe and W. W. Eckenfelder, Jr., edited these papers dealing with current practices in the field of waste treatment. Part one is concerned with anaerobic digestion while part two discusses the separation of solids from waste waters by sedimentation and flotation. Part three discusses elutriation, chemical conditioning, and vacuum filtration. The volume is made up of papers presented at the Conference on Anaerobic Digestion and Solids Handling, New York 1957. (1958, Reinhold Publishing Corp., 430 Park Avenue, New York 22, N. Y. 330 pp., bound. $11.50.)

Calcul De L'ecoulement En Conduites Sous Pression Ou a Surface Libre D'Apres La Formule De Manning—Strickler

An extensive compilation of tables by P. H. Arghyropoulos for the calculation of water flow in pressure conduits, and in channels with free surface, both open and covered. Under each of the main classes the tables are subdivided by cross-section—circular, ovoid, trapezoidal, etc.—and figures are given for small dimensional changes over a wide range of size and shape. Graphical representation is a feature of some sections and numerical examples are given. (1958, Dunod, Paris, France. 326 pp., 3800 fr.)

The Calculation Of Load And Torque In Hot Flat Rolling

Through recent work with high speed compression testing machines, stress-strain data have become available for different types of steels at temperatures and deformation rates applicable to the hot-rolling process. The present volume by P. M. Cook and A. W. McCrum presents a series of graphs for the determination of load and torque, utilizing this data. The graphs are preceded by a brief explanatory introduction. (1958, The British Iron and Steel Research Association, London, England. 109 pp., £3.)

Creativeness For Engineers

The volume consists of two parts, the first of which discusses a philosophy to stimulate creativeness and to motivate the potentially creative person. The second part deals with a creative approach aimed at producing a more effective reaction between the individual and his effort. Donald S. Pearson gives appendices which provide means for practical application of these principles. (1958, Published by the Author, Pennsylvania State University, University Park, Pa. 122 pp., $3.75.)

Engineering Economy

Third Edition

The author deals with the various stages of planning from the inception of an idea to its development and design phases, including the design and operation of a factory to produce the product. This edition of Clarence E. Bullinger's book brings cost data up to date and introduces new operations research procedures, particularly the concept of "models" and "criteria." The effect of state and federal taxes on engineering projects is treated for the first time. (1958, McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y. 379 pp., 9¼ in., bound. $7.00.)

Engineering Materials

This volume is divided into three parts, the first of which deals with various kinds of aggregates, cements, concretes, bituminous materials, stone, timbers, glass and plastics. The second part deals with properties of metals and alloys including alloy steels, wrought iron, cast iron, malleable cast iron, and nonferrous metals and alloys. It concludes with the preservation and testing of materials. The authors, the committee on Engineering Materials, are a group of engineering materials professors in American universities. (1958, Pitman Publishing Corporation, 2 West 45th Street, New York 36, N. Y. 616 pp., $8.50.)

Experimental Designs In Industry

The first section reviews classical designs and provides an account of factorial experimental designs in both complete and incomplete blocks. In addition it gives a detailed description of regression analyses. The second section provides actual illustrations of the use of incomplete blocks, fractional factorial and response surface designs in industrial research. The book, edited by Victor Chew, consists of papers delivered at a 1956 symposium at North Carolina State College, sponsored by the Air Force Office of Scientific Research. (1958, John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 268 pp., $6.00.)

A History Of Technology

Volume IV: The Industrial Revolution

This presents a detailed account of the rise of modern industrialism. Six aspects are discussed: primary production; forms of energy; manufacture; static engineering; communications; scientific basis of technology. The volume, edited by Charles Singer and others, is superbly printed and illustrated. (1958, Oxford University Press, 417 Fifth Avenue, New York 16, N. Y. 728 pp., $26.90)

Hydrodynamics In Ship Design

Harold E. Saunders, presents a thorough exposition of the principles governing the flow and motion of water and their effect on the behavior of a ship and its propulsion devices. Volume one includes flow around and motion of the simple ship, while volume two includes prediction procedures and reference data as well as hydrodynamics applied to the actual design of a ship. Emphasis is on the merchant ship although consideration is given to the submarine, icebreakers, ferryboats, tugs, yachts, etc. (1957, The Society of Naval Architects and Marine Engineers, 74 Trinity Place, New York 6, N. Y. 2 vols., $30.00.)

International Conference On Soil Mechanics And Foundation Engineering

Proceedings of the Fourth Conference, London 1957, Volume 3.

The present volume contains the official records of the meeting, extensive discussions on the papers, and an author index to contributors. This completes this important publication covering practically all phases of soil mechanics and foundation engineering. (Butterworths Scientific Publications, London, England; Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 291 pp., $79.50, 3 volume set.)

(Continued on page 124)

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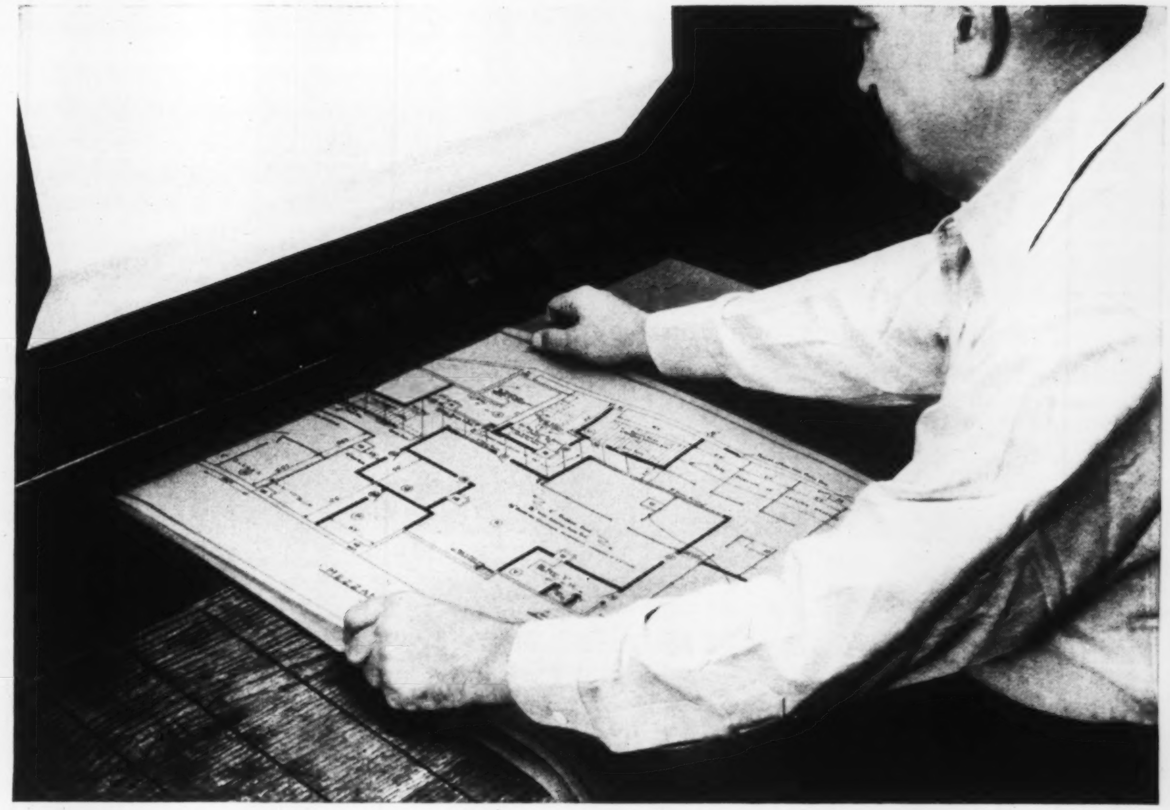

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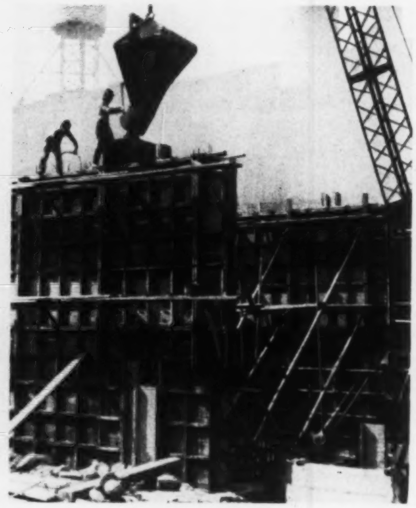

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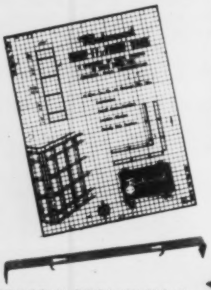

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Recent Books

(*Continued from page 122*)

Das Kriechen Unbewehrten Betons

This brief volume is a detailed study of the literature on the creep or flow of unreinforced concrete which presents the available data in graphical or tabular form. This deals mainly with compression loading, the study also covers tensile and torsional stresses. Results of 186 tests are tabulated and a bibliography of over 200 sources is included. (Published 1958 as Deutscher Ausschuss für Stahlbeton, Heft 131 by Wilhelm Ernst & Sohn, Berlin, Germany. 74 pp. 20 DM.)

The Law Of Water Allocation In The Eastern United States

This book gives an analysis of riparian law in three eastern states and a review of certain types of water use in western law and practice. Two case studies of problem areas are then used as a focus for a discussion of economic and policy issues, while two papers are devoted to water law and state water planning and development in general. The volume, edited by David Haber and Stephen W. Bergen, constitutes the papers and proceedings of symposium sponsored by the Conservation Foundation in 1956. (1958, The Ronald Press Company, 15 East 26th Street, New York 10, N. Y. 643 pp. $7.50.)

Materials And Methods Of Architectural Construction

Third Edition

A completely rewritten edition of a standard work. Harry Parker and others present and explain modern design formulas and current working unit stresses. Among the many new areas discussed are tilt-up, lift-slab, lamella, and stressed skin construction; air-entraining cement; modular coordination; aluminum alloys and monel metal; tempered plate glass and plexiglass; flat-plate design; and the slab-band system. (1958, John Wiley & Sons, Inc., 4 Fourth Avenue, New York 16, N. Y. 724 pp. $12.00.)

Recent Advances In The Engineering Sciences: Their Impact On Engineering Education

This is a survey of the educational implications of a number of expanding areas including automation and automatic control; operations research and systems engineering; thermo-dynamics; mass, momentum and heat transfer; nuclear engineering; solid state physics and engineering materials; computer development and applications. The book is a report of the proceedings of the Conference on Science and Technology for Deans of Engineering, held at Purdue University in September 1957. (Published 1958 by the McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y. 257 pp. $4.75.)

Stahlbetonkonstruktionen

This translation from the Russian covers a wide range of design methods for reinforced concrete, based on various stress conditions. In addition to floors, roofs, etc. of the ordinary types of buildings, K. W. Sachnowski's book treats monolithic engineering structures, prestressed construction, silos and bunkers, and specialized types of reinforcement. Detailed calculations are given, and a supplement provides tabulated dates. (1956, Verlag Technik, Berlin, Germany. 846 pp. 61 DM.)

Symposium On Bond And Crack Formation In Reinforced Concrete

These papers of a 1957 conference, the Réunion Internationale des Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions, discuss the bond between reinforcing bars and concrete; crack spacing and crack width in reinforced concrete components, beams, and finished structures; the influence of crack formation on

(*Continued on page 130*)

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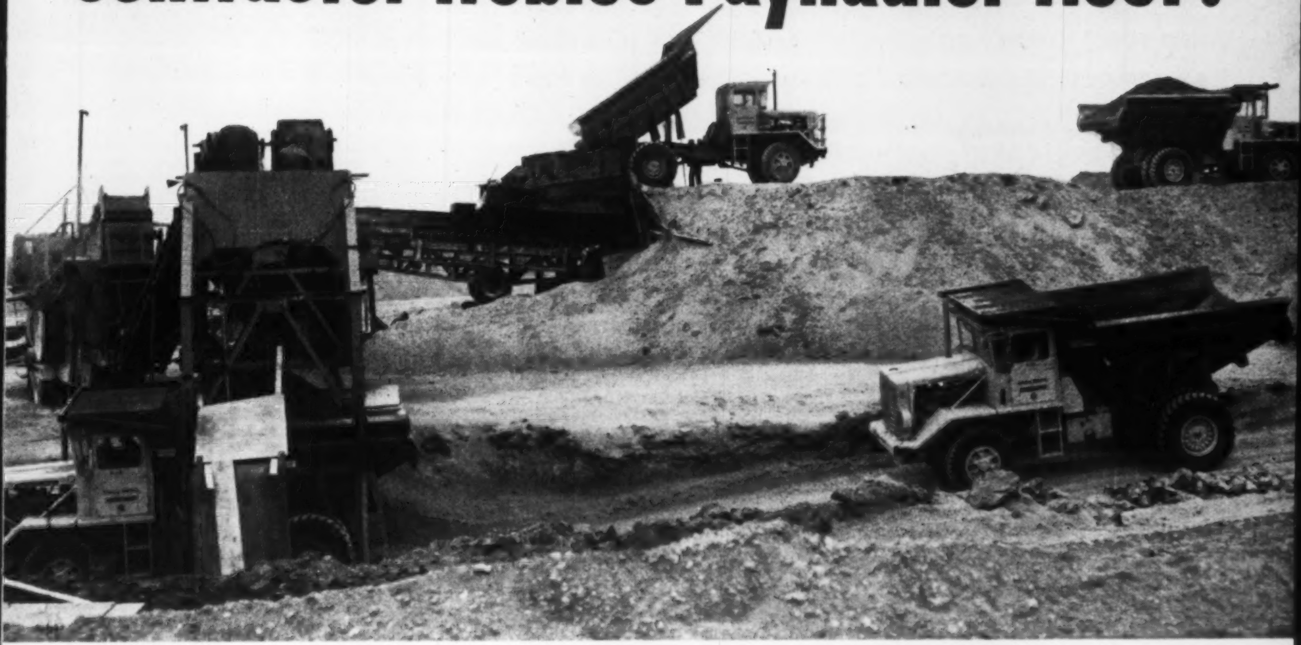

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"First we bought three Payhaulers and three competitive haulers. When we found it took two of them to equal one Payhauler, we got three more Internationals. Now (with more hauling) we have added another three, to give us nine Payhaulers.

"We've never had better equipment. Payhauler power, speed, and fast dumping cut cycle time. Operators go for Payhauler operating ease and riding comfort."

International Payhauler models give you fast getaway with a bonus of turbo-charged diesel power. They have a gear choice to match every load and road. And they provide the power-cushioning leverage of full-floating planetary drive axles, to minimize the slam-bang shock of off-road full-load hauling!

Try Payhauler "pick-up truck" spotting ease—assured by "zip-around" power steering and exclusive high reverse. Prove full-load ramp-climbing "muscle"—and up to 25% faster haul speeds. See how 7½-second dumping and Payhauler operating ease and safety figure sharply in out-hauling other makes, up to 2-to-1! See your International Construction Equipment Distributor for a demonstration.

With extra-large air brakes, air-assisted clutch, and integral hydraulic steering, the "65" Payhauler gives fingertip operating ease—even when hauling 18-ton loads over rough terrain. This pair is stockpiling aggregate for Cage Brothers.

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A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

Civil Engineer, J.M. ASCE, B.S.C.E., 28. Six months' laboratory engineer, steel industry; one year property surveying including chief of party, computations; one and one-half years' plant engineer, including supervision, design and inspections (cement industry). Desires a responsible position with a future in the civil engineering field. Location desired, East and South. C-368.

General Manager, Chief Engineer, or Superintendent, M. ASCE, registered, 52. Many years' full supervision of operations engineering and construction with water utilities, municipalities petroleum companies, contractors and consultants. Heavy management experience. Fluent Spanish. Excellent organizer. Location desired, U.S.A., Latin America, Spain. C-369.

Field/Office Engineer, J.M. B.C.E., 28, New York State P.E. license. Six years' experience as field and office engineer—(test, topo survey, highway construction). Desire responsible position as professional field and/or office engineer. Location desired, New York City or Westchester. C-370.

RESEARCH ENGINEERS

If you —

1. are experienced and interested in the field of Experimental Stress Analysis,
2. would like to work with a group that has a national reputation in this field,
3. desire to apply experimental analysis techniques to a wide variety of both industrial and government problems,
4. enjoy working in communication and close professional contact with men from other significant scientific and engineering fields,
5. have an M.S. Degree or equivalent in specific experience,
6. would like to join the staff of one of the largest independent research organizations in the world,

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E. P. Bloch
ARMOUR RESEARCH FOUNDATION
of Illinois Institute of Technology
10 West 35th Street
Chicago 16, Illinois

Civil Engineer, J.M. ASCE, B.C.E., M.S.C.E., structural major, 28. Two years' experience stress analysis ram-jet engines. Completing three years' active duty Civil Engineer Corps, U. S. Navy in September. Desire position in structural engineering field, preferably design. Engineer-in-training, New York. Location desired, Northeast, preferably New York City area. C-371.

Field/Office Engineer, J.M. ASCE, B.C.E., 24, registered E.I.T. Two years' experience in street layout and design, drainage, right of way layout acquisition, preparation of construction plans. Party Chief. Desires responsible and challenging position in state of Florida. C-372.

Structural Engineer, A.M. ASCE, 53, registered. Seeks position at supervisory level. Competent to direct structural design for architectural or engineering firm on steel and concrete structures, or supervise design, estimating and detailing for fabricator. C-373.

Civil Engineer, M. ASCE, 62, degrees, state licenses. 35 years' experience; design, construction and administration; bridges, parkways, thruways, airports, harbor works, railroads, underpinning and foundations. C-374.

Civil Engineer, J.M., ASCE, B.S.C.E., 28, registered. Nine years' diversified design and construction experience in corps of engineering and in mining and chemical industries. Now employed responsible plant engineering position with large chemical company. Previous foreign experience. Desires plant engineer or construction. Location desired, Western U. S. or Foreign. C-375-896-Chicago.

Civil Engineer, J.M. ASCE, B.C.E., 26. Three years' general construction experience covering most phases of building construction, seeks position that will permit acquisition of a varied background eventually leading to P.E. license and an administrative position. Location desired, Northeast. C-376.

Assistant Resident Engineer, A.M. ASCE, Diploma civil engineering, 36. Two years', assistant administrator, assistant resident engineer of tobacco warehouses and grain silos. Also assisted project engineer in estimating and obtaining data for design of irrigation and drainage projects. Eight years' structures and building construction. Location, U. S. or Foreign C-377-9822-Detroit.

Civil Engineer, Structural and Sanitary, A.M. ASCE, B.Sc.C.E., licensed P.E.—New York State, 33. Nine years' of diversified experience, water works, sewage disposal, and industrial structures. Knowledge of structural design, investigations, appurtenances, codes, specifications, as well as job management, field coordination, workmanship and quality control. Location desired, prefer New York City, Westchester and vicinity, but willing to relocate. C-378.

Civil Engineer-Construction, J.M. ASCE, B.S.C.E., 29, speak, read and write Spanish. Two years' overseas oil field construction; two years' U. S. refinery construction, pipe line construction. Location desired, U. S. or Foreign. C-379-899-Chicago.

Professor, A.M. ASCE, C.E., Ph.D., 50. Twenty years' experience teaching fluid mechanics, hydraulic engineering, hydrology, and sanitary engineering. During past several years' hydraulic design engineer with leading consulting engineering firm. Desire to return to teaching. Location preferred, West Coast. S-1721-San Francisco.

Assistant Professor, A.M. ASCE, M.S., 48. Three years' design of dams, bridges on Mississippi; 21 years' Corps of Engineers as an officer. Have professional registration as civil engineer in California. Location desired, West Coast. S-1164-San Francisco.

Positions Available

Cost Engineer, graduate civil or mechanical, with a minimum of five years' experience in chemical or oil refinery construction costs. Ordinary estimating experience will not be satisfactory. Salary, $9,600 a year. Location, New York, N. Y. W-6233.

Teaching Personnel in engineering, mathematics, physics and chemistry. Program of development included strengthening faculty, inaugurating a graduate program and designing a new science and engineering building. Location, Middle East. F-6237.

Sanitary Engineers, graduates, to deal with sanitary engineering, public health and sanitation problems such as water systems, their design, construction and operation, chemical and bacteriological analyses; design and construction of sewage treatment plants, soil conditions relating to septic tanks and sewage disposal; other health aspects of housing environment. Must have ability to direct and coordinate professional engineering problems in connection with technical research, design, development, planning or comparable functions. Salaries, $8,645 a year. Locations, Milwaukee, Chicago and Minneapolis. W-6238.

Survey Engineer, B.S.C.E., with five years' experience as chief of party on field surveys. Salary, $10,800 a year. Location, North Africa. F-6264(b).

Instructors, for Civil Engineering Department, B.S. degree desirable. Graduate courses available. May do research, teach, or practice during summer. Salary, $4,200 for nine months. Location, South. W-6274.

Resident Engineer, graduate or registered civil engineer with a thorough practical knowledge of breakwater, jetty and pier construction and both hydrographic and topographic surveys, to supervise construction of a small shallow water port. Salary, $12,000 a year, plus travel and expenses. Location, West Africa. F-6280.

Field Engineer, graduate civil or architectural with structural design and field experience. P.E. license desirable. Must be qualified to understand problems of design in structural steel; be interested in promotional work and able to present subject well. Salary, $6,500-$7,500 a year plus fringe benefits. Company will negotiate placement fee; will pay relocation expenses. Location, Philadelphia, Pa., with traveling in Pennsylvania, Maryland and Delaware. W-6307.

(Continued on page 127)

ESPS

(*Continued from page 126*)

Structural Engineer with five to ten years' experience, who can prepare framing plans for building construction and assist with routine steel and concrete design, for a firm of architects. Salary open. Location, Connecticut. W-6334.

Assistant City Engineer, degree in civil engineering; licensed N. J. Professional Engineer and land surveyor or ability to qualify for same; eight years' experience in municipal engineering work, including three in a responsible supervisory capacity. some experience with Building Codes, Zoning Ordinances; a thorough knowledge of modern engineering practices and procedures in the field public works maintenance and construction. Will assist city engineer in the supervision of all activities in department of public works, including engineering division, building division, street and sewer division, etc. Apply by letter giving full details including salary requirements. Location, northern New Jersey. W-6356.

Structural Engineers. (a) Project Manager, conversant in all phases of structural engineering, reinforced concrete and steel, particularly in multi-stories buildings. Must be able to perform preliminary structural studies, do own design and drafting. (*b*) Senior Designer for special structures. At least four years' experience. Must be conversant in the theory of structural engineering and have adequate knowledge in field construction methods. Knowledge of prestressed concrete. Prefer an applicant with a Master's degree in structural engineering. Location, New York, N. Y. W-6372.

Engineer, mining or civil, for open pit nonmetallic operation, with some industrial experience. Salary, to start, $6,240 a year, plus company paid fringe benefits. Location, Southeast. W-6388.

Structural Engineer, graduate, with three to five years' experience in the design of steel, wood boxes, containers, trailers, etc. Salary open. Location, New York, N. Y. W-6393.

Project Engineer, Earth Dams; graduate civil, with P.E. license; to take charge of design of several small earth dams. Experience in channel work, heavy civil works and general hydraulic experience required. Flood control and field work desirable. Permanent position. Location, Massachusetts. W-6418.

Design Engineers. (*a*) One with from five to ten years' experience in the design of large dams. (*b*) One with from five to ten years' experience in general civil and structural design such as power houses, and heavy hydraulic structures. Salaries, $14,000 a year plus living allowance. Location, Far East. F-6422.

Sales Engineer, Sanitary, B.S. in sanitary or civil engineering, with five or more years' in sanitary engineering design, construction and sales. With a knowledge of high level sales management for manufacturer of sanitary sewage and waste treatment plant equipment. Must have demonstrated sales record in sanitary field. 25 percent travel for a manufacturer. Salary, $10,000 plus, depending on ability. Employer will negotiate placement fee. Headquarters, Chicago. C-6948.

Engineers. (*a*) Soils Engineer, graduate civil, with three or more years' experience in highway or airfield pavement. Will contact highway departments, federal agencies and consultants involved in pavement design and construction. Will travel throughout United States. (*b*) Highway Planning and Administration Engineer, graduate civil engineer, with experience in highway economics, planning and administration in state and in highway department of U. S. Bureau of Roads. Will contact highway engineers of state, county, city highway and street departments and consulting engineers involved in highway design. Travel throughout the U. S. for a trade association. Salaries open. Employer will pay placement fee. Headquarters, Chicago. C-6951.

Architects. (*a*) Architect, registered, graduate, with four or more years' experience in architectural office work on industrial and commercial buildings. Salary, $8,000-$10,000 a year. (*b*) Architectural Draftsman, all board work on a variety of buildings, industrial, commercial and contemporary. Salary, up to $7,200 for a consultant. Employer will pay placement fee. Location, Iowa. C-6954.

Head-Construction, Materials test department, B.S. and know soils mechanics. Must know compilation of soil, bituminous and cement/concrete testing equipment catalog; location of suppliers of such equipment; sales (mail-order and personal contact) for a supplier of scientific equipment. Salary, $6,000-$9,000 a year depending on ability and experience. Employer will negotiate placement fee. Location, Chicago. C-6955.

Civil Engineers, B.S. and California license required, with experience on roads, tunnels and dam structures, to work with project engineer in the administration of contracts for owner of multi-million dollar project. Salary, $7,764-$9,456 a year. Location, California. S-3666.

Civil Engineer, public works, graduate civil or equivalent, with a minimum of eight years' responsible experience in civil engineering, at least four years' of such experience on managerial or supervisory level in commercial firm or government facility; know design, construction of bridges, roads, area and structural utilization, POL and ammunition facilities, utility systems and housing development, familiar with programming and scheduling. To advise and assist planning, design, construction and maintenance of bridges, roads, airstrips, parade grounds, utility system drainage and sanitary facility; plans, specifications, estimate for construction and maintenance; act as technical consultant. Salary, $10,200-$12,000 a year. Location, Korea. S-3679.

Construction Project Engineers, public works, graduate civil or architectural or equivalent, with eight years' responsible experience in civil or architectural engineering, four years' of such on managerial or supervisory level in commercial firm or government facility, good letter and report writer. Must be experienced in the design and construction of bridges, roads, area and structural utilities, ammunition facilities, utility systems, housing development, architectural plans, specifications, estimates, bills of materials and construction and rehabilitation of structures and facilities, master planning and construction programming, development construction materials required. Act as special advisor to chief of section, construction division. Salary, $10,200-$12,000 a year. Location, Korea. S-3680.

Architectural Engineer, public works, graduate, or equivalent, with eight years' experience in architectural engineering; four of which should be at management or supervisory level. Knowledge of achitectural engineering plans, specifications, estimates, bill of materials, construction and rehabilitation of structures and facilities, programming and scheduling. Advise and assist plans, specifications, maintenance of buildings and structures, familiar with structural requirements in building construction, prepare plans, specifications, estimates for construction and maintenance of buildings and structures. Review construction project, bill of materials, inspection; act as technical consultant in architectural and construction matters. Salary, $12,000 a year. Location, Korea. S-3683.

Repair and Utilities Specialist, degree in construction engineering or equivalent; eight years' experience; four in managerial or supervisory level. Knowledge of repairs, maintenance roads, grounds, buildings, utilities and related equipment. Capable program planning scheduled work, supervise preparatory plans, specifications, esti-

(*Continued on page 129*)

ENGINEERS

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PREFER GRADUATE REGISTERED ENGINEERS WHO SEEK LONG RANGE EMPLOYMENT WITH AMPLE OPPORTUNITY FOR PROFESSIONAL DEVELOPMENT AND ADVANCEMENT IN A STEADILY EXPANDING AND GROWING ORGANIZATION.

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Work will be in the general offices in St. Louis. Interviews can be arranged in Washington, D. C., and San Francisco also.

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Challenging opportunities exist in the Structures Section for creative and imaginative research engineers. These positions offer an opportunity to work in small project groups in an intimate environment with some of the leading engineers in this field. We need men who are interested or have experience on research problems in:

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These positions are non-routine and require men with initiative and resourcefulness. Degree in Mechanical Engineering, Civil Engineering or Mechanics required.

Excellent employee benefits including tuition free graduate study and a liberal vacation policy. Please send resume to:

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Chicago 16, Illinois

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This is not an advance ticket order. Do not send payment. No name is needed.

To: Mr. Thomas J. Fratar
General Chairman,
Annnual Convention Committee, ASCE
33 West 39 St., New York 18, N. Y.

It is my plan to attend the Annnual Convention. I shall have ...... guests attending with me.

During the Convention I plan to attend the following events, tickets for which I shall purchase when I arrive and register:

Function	No. of Tickets
Mon., Oct. 13	
Luncheon	.....
Kickoff Party	.....
Tues., Oct. 14	
Luncheon	.....
Wed., Oct. 15	
Luncheon	.....
Dinner-Dance	.....
Thurs., Oct. 16	
Cabaret Night	.....

Annual Convention of ASCE

Hotel Statler-Hilton, New York, N. Y. Oct. 13-17, 1958

(*Please print*)

Name ....

Street ....

City .... Zone ...... State ....

Mail to:

ASCE Convention Reservations
Hotel Statler-Hilton, 7th Ave. & 32nd St., New York, N. Y.

Please reserve for my occupancy the following hotel accommodations:

Double .... Single ....

Double-twin beds .... Suite ....

Other ....

Date and hour of arrival ....

Date of departure ....

ESPS

(Continued from page 127)

mates, direct project through completion; procurement, receiving, storing and issuing of supplies. Under own initiative, inspection, studies. Under engineer direct, coordinate activities in repair and utilities program; technical consultant to engineer in construction, major repair, operations of utility plants and systems, inspects, plans, etc. Salary, $10,800-$12,000 a year. Location, Korea. S-3684.

ENGINEER-SURVEY SPECIALIST, C.E. training or equivalent or experience surveying, drafting, map reproduction; civilian teaching experience or equivalent military teaching or experience. Minimum of six years' experience, three of which as chief surveyor or as instructor of surveying. Know topographic and construction survey, computing, drafting; general knowledge of phototransferring, color reproduction and lithographic process. Know surveying, drafting and reproduction equipment, and military map reading and approved Army methods of instruction. Advise and assist planning, prepare and supervise courses of instruction in topographic and construction survey and computing; map reading, use and maintenance of instruments, etc. Salary, $10,800. Location, Korea. S-3685.

SENIOR ENGINEER, Consulting Firm, civil structural and mechanical engineers, to associate with consulting firm with offices in northern California and Hawaii. Experience in water supply and waste water disposal, pipelines and pumping plants, highways, military installations. Salary or profit sharing. S-3703.

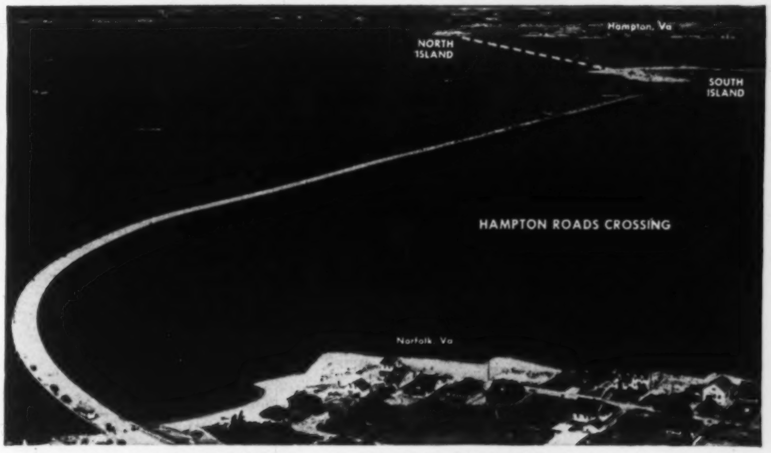
JUNIOR CIVIL ENGINEER, Utilities, for office and field. Recent graduate considered. For design, construction or operating departments of large and growing water utility. Career opportunity. Salary, $5,532-$5,844 after six months; $6,180 after 18 months. Location, San Francisco Bay area. S-3704.

ENGINEERS. (*a*) Design Engineer, water works, graduate civil, with several years' experience in design and planning of water works. Salary, $6,000-$7,200 a year depending on qualifications. (*b*) Junior Civil Engineer, some civil training or graduate civil engineer, knowledge of hydraulics helpful, with some interest in water works, for draft and design of water facilities. Salary, $4,800-$6,000 a year, depending on qualifications. Location, Sonoma County, California. S-3708.

ASSISTANT CIVIL ENGINEER, public works, graduate civil from accredited school and one year full-time work in some phase of civil engineering, preferably hydraulics. Salary, $6,360-$7,728 a year. Location, Santa Clara County, California. S-3714.

TRAINEE-CONSTRUCTION ENGINEER, project management; B.S. in engineering or equivalent, with at least six months' professional engineering experience in two or more branches of engineering. Prepare reports on construction materials or special factory equipment, structural calculations, review shop drawings, translate comments made by project engineers into detailed notes on drawings; rewrite or reword specifications for clarity or to incorporate other equipment, prepare simple drawings, layouts of housing or recisions in electrical or mechanical fixtures in building. Salary, $5,430 a year. Location, San Francisco Bay area. S-3709.

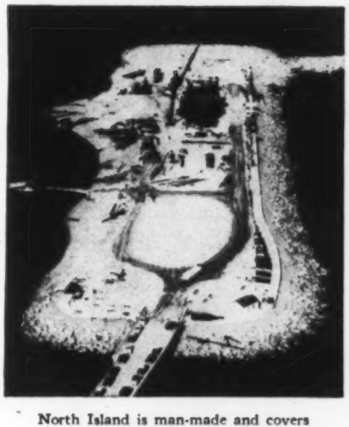
STRUCTURAL DESIGN, laminated wood structures, civil engineer, with good mathematics background, with two to three years' experience in general building construction, with emphasis on structural elements; knowledge of wood applications desirable. Mostly for design of roof components trusses and beams; able to prepare designs and draw ship and construction plans for wood fabrication plants. Salary, $6,000-$8,400 a year depending on experience. Location, Marin County, California. S-3702.



Man-made Islands Connect 6860 foot Tunnel with Two Bridges for Vehicular Traffic at Hampton Roads Crossings, Va. For: Commonwealth of Virginia, Department of Highways. Contractor: Merritt-Chapman & Scott Corp. Consulting Engineers: Parsons, Brinckerhoff, Hall & Macdonald.

Vibroflotation®

was used to compact the sand on these man-made islands and provide a stable base for the foundation of tunnel portals.



North Island is man-made and covers 4½ acres. Its approach strip and entrance has foundation compacted by VIBROFLOTATION. The same is true of South Island.

The tunnel portals of North and South Islands are supported in a compacted mass of sand to prevent possible future foundation settlements.

A bed, 20 ft. deep and 50 ft. wide, was compacted to support the ramps from bridge to tunnel. Maximum depth of vibroflot penetration was 62 ft. Minimum depth was 10 ft.

Write for Booklet C-13

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ATlantic 1-2500

V-13

Recent Books

(*Continued from page 124*)

the durability of concrete structures; the effects of bond on anchorage and splicing of reinforcement bars; simplified rules and specifications dealing with crack width in different countries. (1957, Swedish Cement and Concrete Research Institute, Stockholm, Sweden. 2 vols. 100 s.)

Torsionstheorie

A highly mathematical treatment of torsion theory, by Constantin Weber and Wilhelm Günther, which presents not only the well-known methods of solution of torsion problems in the field of elasticity but also certain original treatments devised by one of the authors. One major aim is to demonstrate which methods are most suitable for specific types of problems as well as to give detailed solutions. (1958, Friedrich Vieweg & Sohn, Braunschweig, Germany. 307 pp. 38 DM.)

Positions Announced

City of Riverside, Calif. Vacancy for Assistant Civil Engineer in the Public Works Department. Applicant must be college graduate with two years' experience. Salary range—$500-608 monthly. For applications, write to Personnel Director, City Hall, Riverside, Calif.

City of Torrance, Calif. Vacancy for Director of Public Works. Applicant must have California registration, eight years' experience in professional civil engineering, including three years of supervising a variety of public works. Salary range—$1,052-1,160 monthly. Closing date is September 10. Send applications to Personnel Office, City Hall, Torrance, Calif.

International Cooperation Administration. Vacancies for Sanitary Engineers for overseas employment. Salary range—$8,000-13,000 plus housing and other allowances where applicable. Applicants must have degree in either sanitary engineering or public health for subordinate positions, with appropriate experience for positions of more responsibility. Minimum assignment is two years. For information write Public Health Division, Box 100, International Cooperation Administration, Washington 25, D. C.

U. S. Army. Vacancy in Sacramento District, Corps of Engineers, for Hydraulic Engineer, GS-11, to handle hydrological work. Salary range—$7,510-8,230. Send applications airmail to U. S. Army Engineer District, Sacramento, P. O. Box 1739, Calif.

U. S. Navy. Vacancies for Civil Engineers, GS-9, on Midway, to handle construction, design and specifications, and a Civil Engineer on Guam, with design experience. Apply to Navy Overseas Employment Office (Pacific) Section A, 45 Hyde St., San Francisco 2, Calif. Vacancy for Civil Engineer, GS-9 and -11, Mare Island Naval Shipyard. Apply to Employment Superintendent, Code 172, Vallejo, Calif.

Non—ASCE Meetings

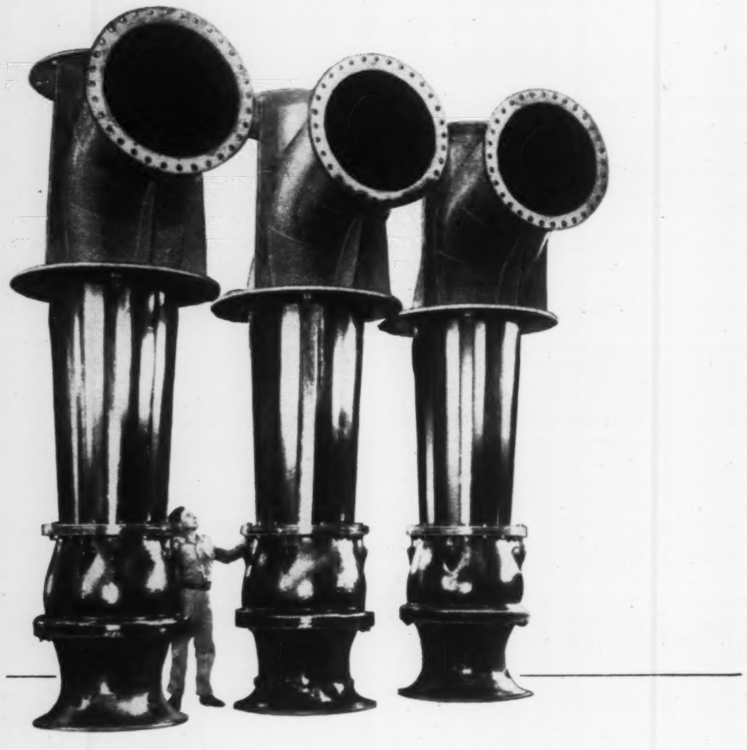
American Bridge, Tunnel, and Turnpike Association. Annual meeting, October 15-18, Richmond, Va., at the Hotel John Marshall. For information write J. A. Stearns, executive secretary, ABTTA, P.O. Box 148, White Plains, N. Y.

American Institute of Chemical Engineers. Thirty-eighth National Meeting, September 21-24, Salt Lake City, Utah, at the Hotel Utah. For information write F. M. Parker, P.O. Box 1889, Salt Lake City, Utah.

American Institute of Mining, Metallurgical, and Petroleum Engineers. Fall meeting of the Society of Petroleum Engineers, AIME, October 5-8, in Houston, Tex. For information write AIME, 29 West 39th Street, New York 18, N. Y.

American Public Health Association. Eighty-sixth Annual Meeting, October 27-31, St. Louis, Mo. For information and hotel registration write the APHA, 1790 Broadway, New York 19, N. Y.

(*Continued on page 131*)



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Non-ASCE Meetings

(Continued from page 130)

American Public Works Association. Public Works Congress and Equipment Show. September 28-October 1, in Kansas City, Mo., at the Municipal Auditorium and the Hotel Muehlebach. For information write the Association, 1313 East 60th Street, Chicago 37, Ill.

Building Research Institute. Conference on Installation and Maintenance of Resilient Smooth-Surface Flooring, September 17-18, Washington, D. C., at the Sheraton-Park Hotel. For information write the Division of Engineering and Industrial Research, National Academy of Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D. C.

Federation of Sewage and Industrial Wastes Associations. Thirty-first Annual Meeting, October 6-9, Detroit, Mich., at the Sheraton-Cadillac Hotel. For information write Association headquarters, 4435 Wisconsin Ave., Washington 16, D. C.

Freeway Operations Seminar. Third seminar, September 24-26, in Northampton, Mass. Information from the Institute of Traffic Engineers, 2029 K Street, Washington 6, D. C.

Instrument Society of America. Automation Conference and Exhibit, September 14-19, Philadelphia, Pa. Details from Fred J. Tabery, Conference and Exhibit Manager, 3343 South Hills St., Los Angeles, Calif.

International Road Federation. Third World Meeting, October 26-31, Mexico City. Information is available from the I.R.F., 1023 Washington Bldg., Washington 5, D. C.

National Association of Corrosion Engineers. Symposium, October 5-8, Boston, Mass. For information write M. M. Jacobson, NACE, Watertown Arsenal Laboratories, Watertown 72, Mass.

National Electronics Conference. Fourteenth annual Conference, October 13-15, Chicago, Ill., at the Hotel Sherman. Sponsored by the AIEE, Illinois Institute of Technology, the Institute of Radio Engineers and Illinois and Northwestern Universities.

National Safety Council. Forty-sixth National Safety Congress and Exposition, October 20-24, Chicago, Ill., at the Hotels Conrad Hilton, Congress, Morrison, and La Salle. For information write R. L. Forney, Secretary, National Safety Council, 425 North Michigan Ave., Chicago 11, Ill.

National Slag Association. Forty-first annual meeting, October 21-22, Washington, D. C., at the Mayflower Hotel. Information from the Association, 613 Perpetual Building, Washington 4, D. C.

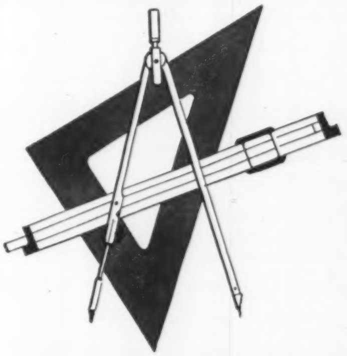
National Society of Professional Engineers. Fall meeting, October 22-25, San Francisco, at the St. Francis Hotel. For reservations write J. A. Sontheimer, Secretary, California Society of Professional Engineers, c/o St. Francis Hotel, San Francisco, Calif.

Prestressed Concrete Institute. Annual meeting and convention of the Institute, September 21-25, Chicago, Ill., at the Edgewater Beach Hotel. Further information available from the Institute, 1958 Convention Committee, Box 391, La Grange, Ill.

Producers' Council. Thirty-seventh annual convention, September 17-19, Miami, Fla., at the DuPont Plaza Hotel. For information write the Council, 2029 K Street, N.W., Washington 6, D. C.

Sixth International Congress on Large Dams. September 15-30, New York City, at the Hotel Statler. Information available from the U.S. Committee on Large Dams, c/o Engineers Joint Council, 29 West 39th St., New York 18, N. Y.

(Continued on page 132)



mechanical joint flexibility
IS GOOD ENGINEERING

The wide use of mechanical joint valves, hydrants, pipe and fittings has proved that this type of construction is good engineering. The joint is bottle-tight and permits deflection, expansion or contraction in a pipe line, without breakage or leakage. Other advantages include rapid and easy joint assembly.

M & H Mechanical Joint Valves and Hydrants are used not only with mechanical joint pipe made by the different pipe manufacturers, but they are easily installed in old bell-and-spigot pipe lines. The joint is made by a bolted gland compressing a thick gasket into a stuffing box. For water, the gasket is rubber but metal-tipped, duck-tipped, Thiokol-tipped and other special gaskets can be supplied. *Write or phone . . .*

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AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF W WALWORTH

Non-ASCE Meetings

(Continued from page 131)

Society of Automotive Engineers. National Aeronautic Meeting, September 29-October 4, Los Angeles, Calif., at the Ambassador. For information write the Society, 485 Lexington Ave., New York 17, N. Y.

Southeastern Association of State Highway Officials. Meeting, September 30-October 2, Birmingham, Ala., at the Tutwiler Hotel. For information write A. R. Harvey, secretary SASHO, Alabama State Highway Department, Montgomery, Ala.

Standards Engineers Society. Seventh annual meeting, September 22-24, Philadelphia, Pa., at the Benjamin Franklin Hotel. For information write the Society, P.O. Box 281, Camden, N. J.

Steel Founders' Society of America. Fifty-sixth fall meeting, September 22-23, Hot Springs Va., at the Homestead. For information write George K. Dreher, Market Development Director, c/o the Society, 606 Terminal Tower, Cleveland 13, Ohio.

Applications for Admission to ASCE, July 5-August 2

Applying For Member

Nicholas Altigos, Athens, Greece.
Carmel Joseph Arcilesi, Bethesda, Md.
Robert William Armstrong, Indianapolis, Ind.
Mark Ernest Barber, Denver, Colo.
Edward Vening Bon Durant, Terre Haute, Ind.
George Bergstrom Bradshaw, Chaman, Pakistan.
Arthur Charles Bravo, Arcadia, Calif.
Wilbur Henry Chamberlin, Denver, Colo.
Harold Eugene Coose, St. Louis, Mo.
Howard Ernst Crail, Cincinnati, Ohio.
Rudolfo Garcia y Cruz, Tehran, Iran.
Carl Anthony Giffels, Detroit, Mich.
Robert Harold Harmeson, Urbana, Ill.
Taizo Hayashi, Tokyo, Japan.
Aake Frans Hedman, Chattanooga, Tenn.
Joseph John Ilgenfritz, Washington, D. C.
John Joseph Justen, Cincinnati, Ohio.
George Alfred Kiersch, San Francisco, Calif.
Frederick Ephraim Kittner, Boston, Mass.
Ernest Bradshaw Mansfield, Pasadena, Tex.
Edmond Michael McCarthy, Danville, Calif.
William Tucker Moody, Denver, Colo.
Edward Arlo Moulder, Austin, Tex.
Waldemar Stanley Nelson, New Orleans, La.
Clarence Webb Nottage, Arlington, Va.
Charles C. Pate, Tulsa, Okla.
Jack Paul Pearson, Alamogordo, New Mex.
Harold Philip Peterson, Maple Heights, Ohio.
John Aldus Phelps, Phoenix, Ariz.
Raughley Lyman Porter, Baltimore, Md.
Hapugoda Rankotge Premaratine, Colombo, Ceylon.
Lee Shannon Rawlings, Oklahoma City, Okla.
Gordon Gurney Robeck, Cincinnati, Ohio.
John Hall Robinson, Erie, Pa.
Henry Kirby Schlegel, San Francisco, Calif.
Frank Benedict Sebastian, Indianapolis, Ind.
Harold Sechster, Flushing, N. Y.
Philip William Sheridan, Holyoke, Mass.
Kurt Hugo Siecke, Portland, Ore.
Leonard Vance Smoot, Cincinnati, Ohio.
Lawrence Byron Utterback, Erie, Pa.
Hans Enoch Wight, Los Angeles, Calif.

Applying For Associate Member

John Atkinson, Syracuse, N. Y.
Ibrahim Suleiman Attour, Amman, Jordan.
Lawrence Joseph Booher, Davis, Calif.
Harvey Ance Brashears, Indianola, Nebr.
Owen Campbell Brewer, Cincinnati, Ohio.
Guerin Edwin Carlson, Boston, Mass.
Albert Wilder Carpenter, Ann Arbor, Mich.
Douglas Robert Carter, New South Wales, Australia.
Robert Henry Carter, Ephrata, Wash.
William Ellis Collord, Cedarville, Calif.
John Philip Conner, Indianapolis, Ind.
Wayne Delbert Criddle, Salt Lake City, Utah.
John Joseph Doyle, Erie, Pa.
Gregory Efstratiadis, Athens, Greece.
Anthony Francis Gaudy, Jr., Urbana, Ill.
Zachariah George, Oklahoma City, Okla.
Willard Claire Hadley, Clarks Hill, S. C.
James Albert Harder, Berkeley, Calif.
Charles Elmer Harding, Rolla, Mo.
James Blaine Harman, Baltimore, Md.
John Bay Heagler, Jr., Rolla, Mo.
Bernard Patrick Healy, New York, N. Y.
Richard Crandall Heath, Ocala, Fla.
Ernest Clair James, Sacramento, Calif.
Gerald Lane Jordan, Bryan, Tex.
Donald Peard Kay, Permanente, Calif.
Lewis Parker Kell, Kansas City, Mo.
Peter Henry Norris Kendall, Kailua, Hawaii.
Kurt Karl Klein, Tonawanda, New York.
Frank Peter Koczur, Newark, N. J.
Richard Alan Lili, Washington, D. C.
Richard Denis Clendinning Lloyd, Toronto, Ontario, Canada.
Malcolm Scott MacCalden, Jr., Boston, Mass.
Robert Michael Manyth, West Allis, Wis.
Jorge Manzur, Cordoba, Argentina.
Clarence Robert Margeson, Seattle, Wash.
Robert Holmes McCoy, Tacoma, Wash.
Francisco Mendoza Von Borstel, Mexico, D. F., Mex.
Cloyce Henry Messenger, San Diego, Calif.
Joseph Rudolph Mica, Victoria, Tex.
John Robert Moore, Memphis, Tenn.
Subramantiam Vythilingam Navaratnam, Johore Bahru, Malaya.
Lewis William Owens, Uniondale, N. Y.
Jerome Pepper, New Orleans, La.
Glenn Ray Peterson, Sacramento, Calif.
Dominick Provini, Baltimore, Md.
Loyal Clay Porter, Sacramento, Calif.
William Arthur Read, Jr., St. Petersburg, Fla.
Roger Heath Rice, Webster, N. Y.
William B. Ridgley, New York, N. Y.
Bernard Leo Robinson, Tolono, Ill.
George Jury Ryss, New York, N. Y.
William Thomas Smith, Chicago, Ill.
Raymond Chia Shui Teng, Singapore, Malaya.
Jorgen Tvil stegaard, Minneapolis, Minn.
John Lloyd Waters, Santa Clara, Calif.
Ronald William Woodhead, Sydney, N. S. W. Australia.

Applying For Affiliate

Grover Cleveland Gauntt, Jr., Roselle, Ill.

Applying For Junior Member

Richard Henry Bock, Uniondale, N. Y.
Robert Stephen Broughton, Toronto, Canada.
Mrigendrarya Mukundlal Dave, Bihar, India.
Robert Francis Getsfred, Omaha, Nebr.
Joseph Bernard Gormley, Queens Village, N. Y.
Jack Ernest Horn, Antigo, Wis.
John Edwin Johnson, Detroit, Mich.
John Wescott Kenyon, Chicago, Ill.
Ralph Klimoff, Woodbury Heights, N. J.
Alnoth Holman Krier, Olympia, Wash.
Reginald Anthony LaRosa, Montpelier, Vt.
Timothy Liang Tong Liu, Los Angeles, Calif.
Aboul Hasan Makarechian, Chicago, Ill.
Fernando Martinez, Bogota, Colombia.
Richard John Meagher, Lyttelton, New Zealand.
Joseph Leon Moncada, Jr., Ft. Worth, Tex.
John Patrick Monis, Albany, N. Y.
John Haddow Morrison, Helena, Mont.
Thomas Oliver Nuttle, Baltimore, Md.
Bernard Vincent Pannone, Washington, D. C.
William Guy Paratore, San Francisco, Calif.
Frank James Pettinelli, New York, N. Y.
Bernard Edouard St. Aubin, Montreal, Que., Canada.
Robert Jubilee Stephenson, Marietta, Ga.
Gustaaf Van't Hof, Vernon, Calif.
Jacobus Petrus Verschuren, Edmonton, Alberta, Canada.
Louis Loy Wen, New York, N. Y.
Alfonso Yepes, Bogota, Colombia.

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

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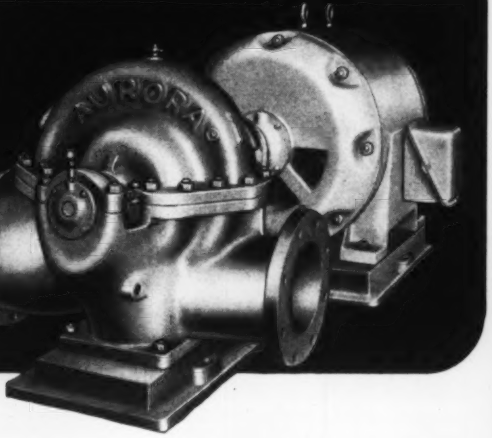
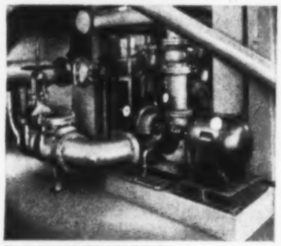
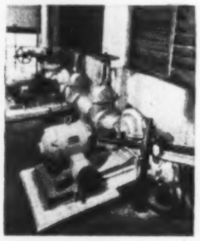


Just one more important reason these **AURORA**® *HORIZONTAL SPLIT CASE, DOUBLE SUCTION* **CENTRIFUGAL PUMPS** give greater servive



Two Aurora Type "O" Centrifugal Pumps, driven by 15HP, 1150 RPM motors are serving as cooling tower pumps in the plant of C. Schmidt & Sons, Inc., Brewers, Philadelphia, Pennsylvania.



Two Aurora Type "O" Condensation Water Pumps are installed in the Hillsborough County Courthouse, Tampa, Florida. Duty, 1400 GPM against 50' TDH at 1750 RPM.

Whether municipality or industry, you want a pump built for long, maintenance-free life. Equally important, when maintenance *is* needed, you want lines back in service fast!

These Aurora Type OJ centrifugal pumps are built for rugged service, and can be quickly maintained without disturbing suction or discharge piping or pump-motor-base alignment.

They are ideal for municipal or industrial water service for line pressure build-up, boosting to pressure tanks or elevated tanks, cooling tower service, fuel transfer, fire pumps, marine service, circulating, boiler feed service and many other general applications.

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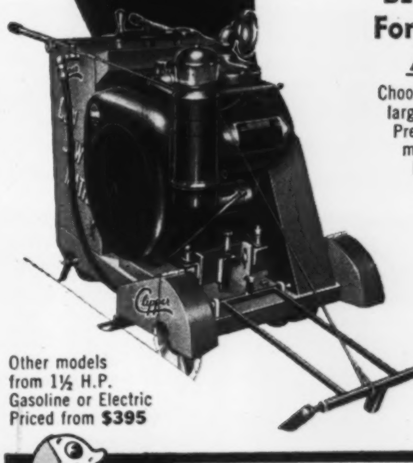

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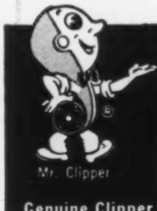

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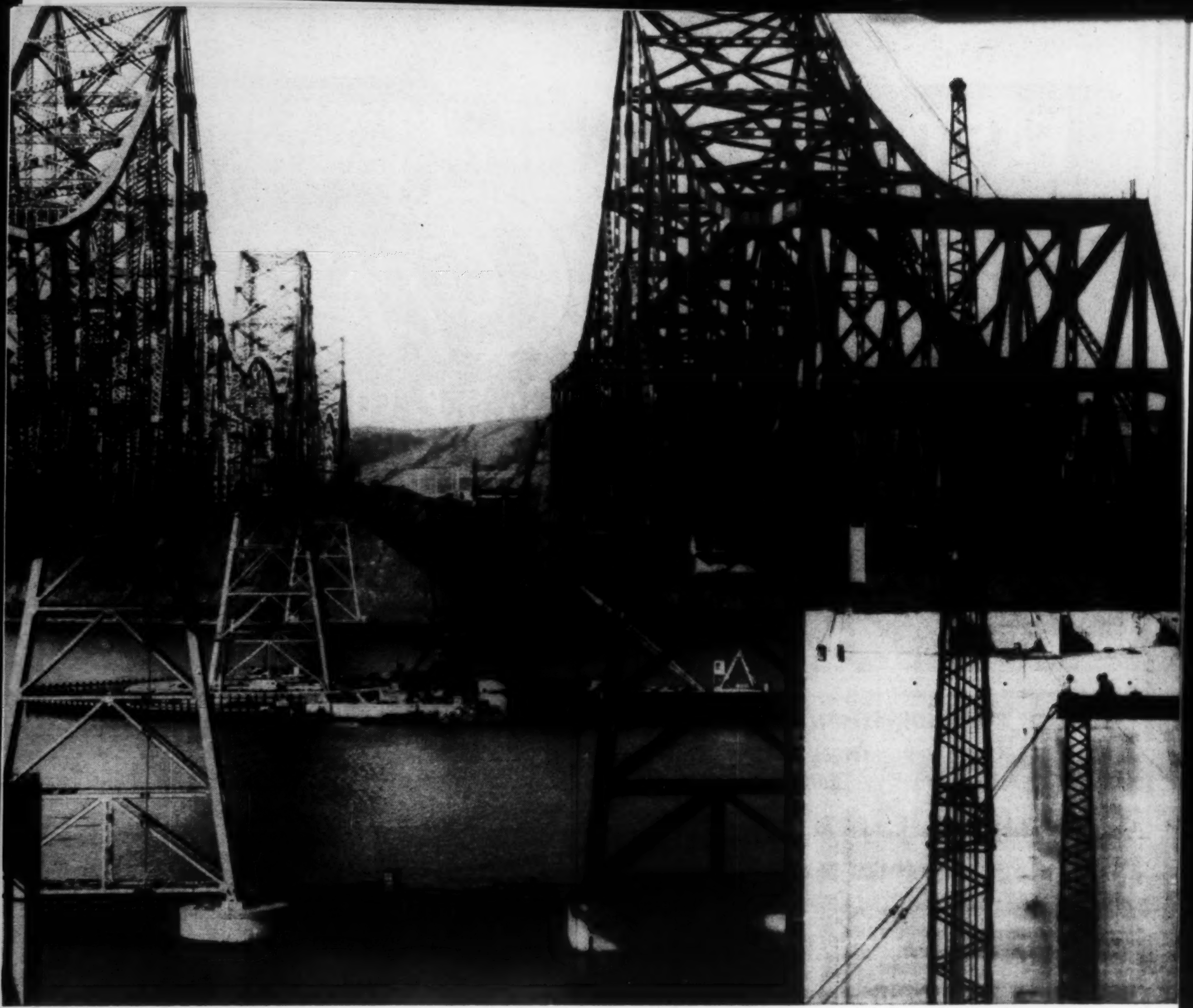


"T-1" Steel Plate now furnished to 100,000 psi minimum yield strength

11% greater strength. USS "T-1" Constructional Alloy Steel can now be furnished to a minimum yield strength of 100,000 psi in plates up to 2½ inches thick. This is in addition to the present types of "T-1" Steel which are still available at a minimum yield strength of 90,000 psi. The new minimum tensile strength—the point at which actual breakage occurs when stressed in tension—has been increased from 105,000 to 115,000 psi. The published tensile strength maximum of 135,000 psi remains unchanged.

Weight reductions up to 50%—or more. Because of its great yield strength, three times that of structural carbon steel, USS "T-1" can be used to save weight in highly stressed members of bridges, TV towers and pressure vessels. Weight savings from 25 to 50% are common. For construction equipment, USS "T-1" Steel's strength, plus high resistance to impact abrasion, boosts payload capacity and increases equipment life.

Cost savings up to 11%. The increase in strength at no extra cost amounts to customer cost savings up to 11%. Use of higher design stresses reduces the fabricating, welding and shipping costs because less material is needed.

The new strength data were arrived at after continuous tests on production lots of USS "T-1" Steel Plates at our Homestead Works. Actual experience confirmed the tests, and it became apparent that higher mechanical properties inherent in USS "T-1" Steel could be consistently developed. **Free book.** For complete technical information on USS "T-1" Steel, write to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

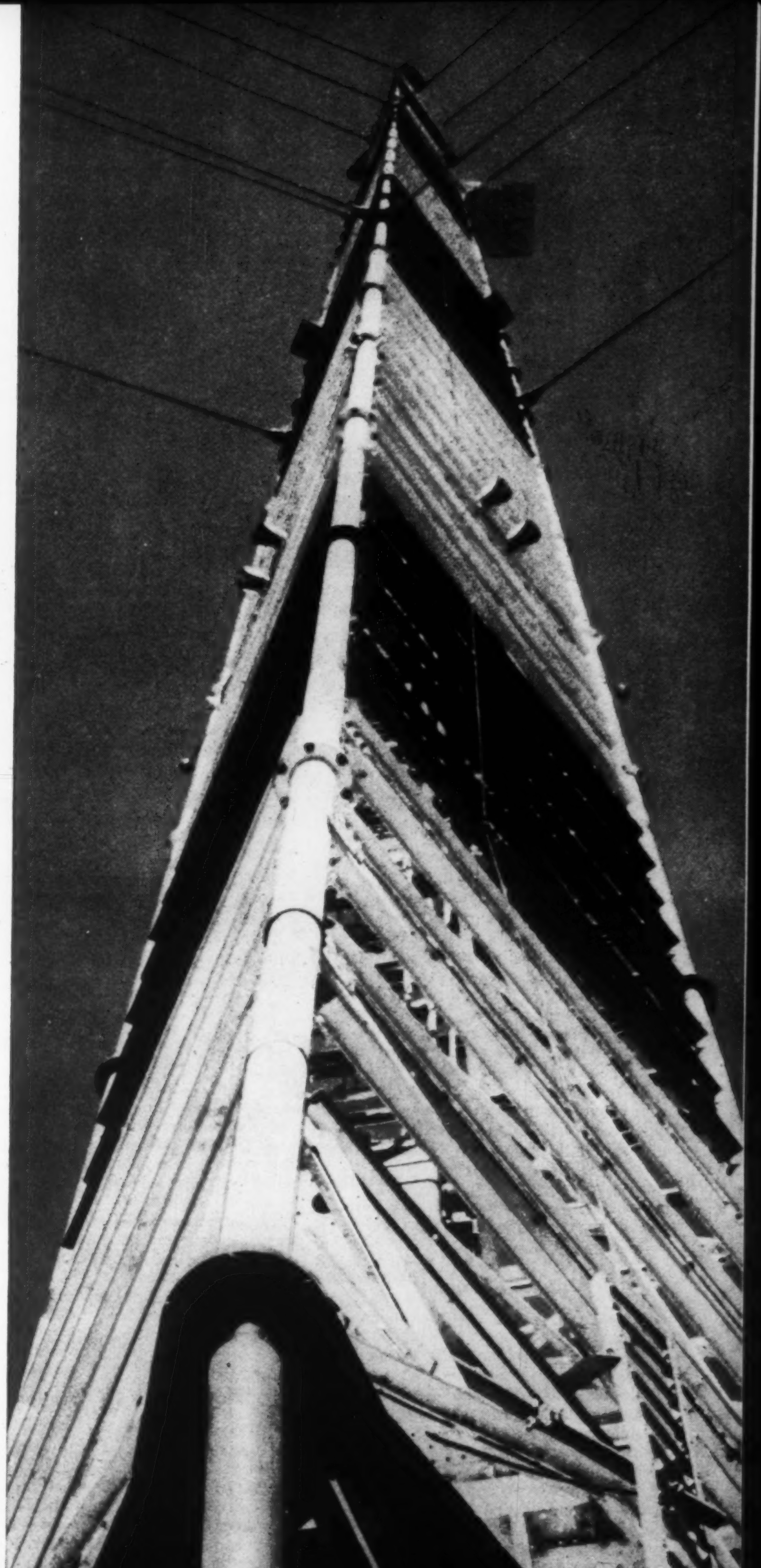
USS and "T-1" are registered trademarks

USS "T-1" Steel saves $800,000. By using this stronger, weldable steel in the heavily stressed members of the New Carquinez Bridge in San Francisco, weight of some members was cut almost in half, with an overall savings of $800,000.

TV tower costs cut 15%. Because of its great strength, USS "T-1" Steel was used in the bottom 838 feet of this 1,199-foot TV tower. The cross-sectional area of the legs was reduced by 44%, resulting in a material and fabrication saving of 15%.

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel



EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Towed-Type Spreader

Designed for aggregate or asphalt spreading from feather-edge to 8-in. depth, the new version of the towed type spreader is uncomplicated but provides fast, smooth, and accurate spreading. A floating strike-off bar is completely independent of the hopper, and accurately controls spread depth. Spread is adjustable from 1 to 10-ft widths and to 8-in. depth. Adjustment of one bolt permits level spread or up to $1\frac{1}{2}$-in. crown or reverse crown. Constant spread control is adjustable without tools and the spreader can produce taper. Depth is controlled by independent roller side runners which do not support hopper weight and thus ride on soft base material without digging or gouging. A universal truck hitch, for practically any dump or semi-dump truck, is quickly attached and readily adjusts to different sizes and types without special attachments.

Fast, Smooth, Accurate

Other features include a lower, wider, more-rugged hopper; an improved operator's platform; and wide steel front rollers to support the hopper box. The spreader is easily carried on a truck tail gate without need for caissons or supporting wheels. **Good Roads Machinery Corp., CE-9, Minerva, Ohio.**

Optical Plummet

A new approach to the problem of setting up a transit over a point without using a plumb bob is available in the new Tele-Plumb and Plano-Shift. According to the manufacturer, this is the world's first optical plummet which can be used to sight to a point directly *beneath* the instrument, or directly *above* the instrument by *sighting through the main telescope of the transit*, and without using a plumb bob. Tele-Plumb is attached to the objective end of the transit telescope and is very easily attached or removed. It increases the length of the telescope only about $1\frac{1}{8}$-in., and in most cases the instrument can be stored in its carrying case without altering the case. The telescope can be used with any change for taking direct sights without any interference from the Tele-Plumb. Provision is however made so that the part of the plummet inside of the telescope can be withdrawn to allow full light and vision through the telescope. This in no way affects the adjustment of the plummet. **Warren-Knight Co., CE-9, 136 N 12th St., Philadelphia 7, Pa.**

Fastening Tool

Extreme light weight, operational simplicity and safety, and low cost, are among the features claimed for the new Drive-It Model 77 powder-actuated concrete and steel fastening tool now being introduced to the building trades.

The manufacturer states that two years of development and field trials have resulted in a number of attractive advantages for users of the Model 77. Although weighing almost a full pound less than any other powder-actuated tool, it drives the full standard range of $\frac{1}{4}$-in. and $\frac{3}{8}$-in. drivepins, using only one caliber cartridge. Exceptionally easy to load, lock and fire with safety, this sturdy, heavy-duty piece of equipment contains only fourteen parts and is simple to lubricate and maintain.

Low Cost

An interchangeable, integrated barrel-guard system makes possible unusually rapid adaptation of the tool to both general application as well as special electrical, lathing and door-buck work. **Omark Industries, Inc., CE-9, Portland, Oregon.**

Waterproof Field Books

Making field notes in rain or humid weather is almost a pleasure with "Rite in the Rain" Waterproof Engineers Field Books. A patented chemical impregnation serves the dual purpose of making the sheet completely impervious to moisture, at the same time improving the writing surface of the paper. Even the hardest pencil makes a clear, sharp mark on a soaking wet page. A complete assortment of waterproof field books are available in 60 leaf bound books, 24 leaf waterproof paper-covered fillers and loose leaf sheets.

Special forms, tags, labels and signs are also available on the waterproof paper, originally developed for use by the forest industry of the Pacific Northwest. **J. L. Darling Corp., CE-9, Browns Point, Tacoma, Wash.**

Four Wheel Drive Tractor

The new Model 24 300-hp four wheel drive tractor contains as standard equipment many revolutionary tractor items such as: insulated cab with air conditioning; radio, heater and defroster; automatic cut-off switch for oil pressure and water temperature; temperature gauges for transmission, transfer case, differential and engine; tachograph, clock, hinged and locked-type doors; double seat with 6-way electric positioning; and air clutch and brakes. A distinctive feature is the reverse slope and dust-free windshield, both front and rear, with tinted safety glass. Except for fuel and air filters, the tractor will require weekly service only, affording maximum work hours, and a minimum of "time out".

Four wheel drive and four wheel positive hydraulic steering are accomplished through the "Pow-R-Flex" Center-Hinge Coupler, which employs two pins and hydraulic cylinders, taking the steering action equally through two lightly loaded drive shaft joints, rather than the conventional knuckles in the final drive axles. No steering clutch or brakes are used, therefore, no loss of power results from turning; the turning radius of the Model 24 is 11 ft, 7 in. The coupler also provides free oscillation of both axles, giving tremendous traction advantage on rough terrain, loose footing and slopes.

No Moving Costs

Chief overall advantages claimed for the tractor are greater speed, maneuverability and versatility, lower maintenance cost, important fuel savings, no moving costs, and greatly stepped-up productivity. **Wagner Tractor, Inc., CE-9, P. O. Box 7444, Portland, Ore.**

In final construction stages is this new International Airport Terminal, Portland, Oregon. Parking area is in right foreground, between curving pedestrian ramps built with Armco Retaining Walls.

Armco Retaining Walls Support Ramps
at New Portland International Airport Terminal

When its new International Airport is completed, The Port of Portland, Oregon, will gain important recognition on the world air map. Assigned to a role in the erection of this 8-million-dollar facility are two installations of Armco Bin-Type Retaining Walls at the airport terminal.

These Armco Walls are identical, extending from each side of the terminal in diminishing heights. They contain the outside slope of the fill on the ramp-type pedestrian approaches to the second floor of the terminal.

Each Armco Wall is 190 feet long, curved in a continuous circular radius of 234 feet, with height ranging from 6.67 to 13.33 feet.

It is planned that the new terminal building will be completed this summer.

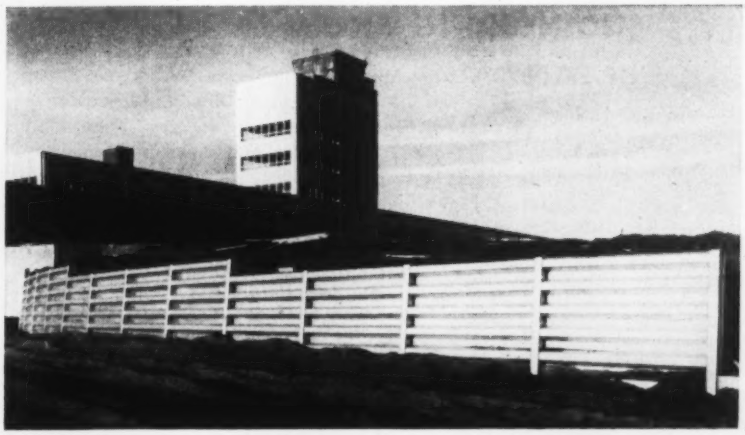
* * * *

Armco Retaining Wall is just one in the group of more than 30 Armco Products for engineering construction. Hundreds of Armco sales engineers are ready to give you quick service and transportation savings from the 56 Armco fabricating plants. For details, write us. Armco Drainage & Metal Products, Inc., 5548 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

Contractor: Ross B. Hammond Co.
Portland, Oregon

Architect: Burns, Bear,
McNeil & Schneider
Portland, Oregon

Close-up of Armco Retaining Walls, after assembly and backfilling. Terminal administration building is in background.



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☐ Send me a copy of the new catalog on Armco Retaining Walls.

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- Technical and professional sessions and discussions
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- Demonstrations of equipment, materials, tools, methods
- Inspection trips to major engineering projects in New York City
- Informal get-togethers—meet old friends, make new contacts

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The Master Builders Company
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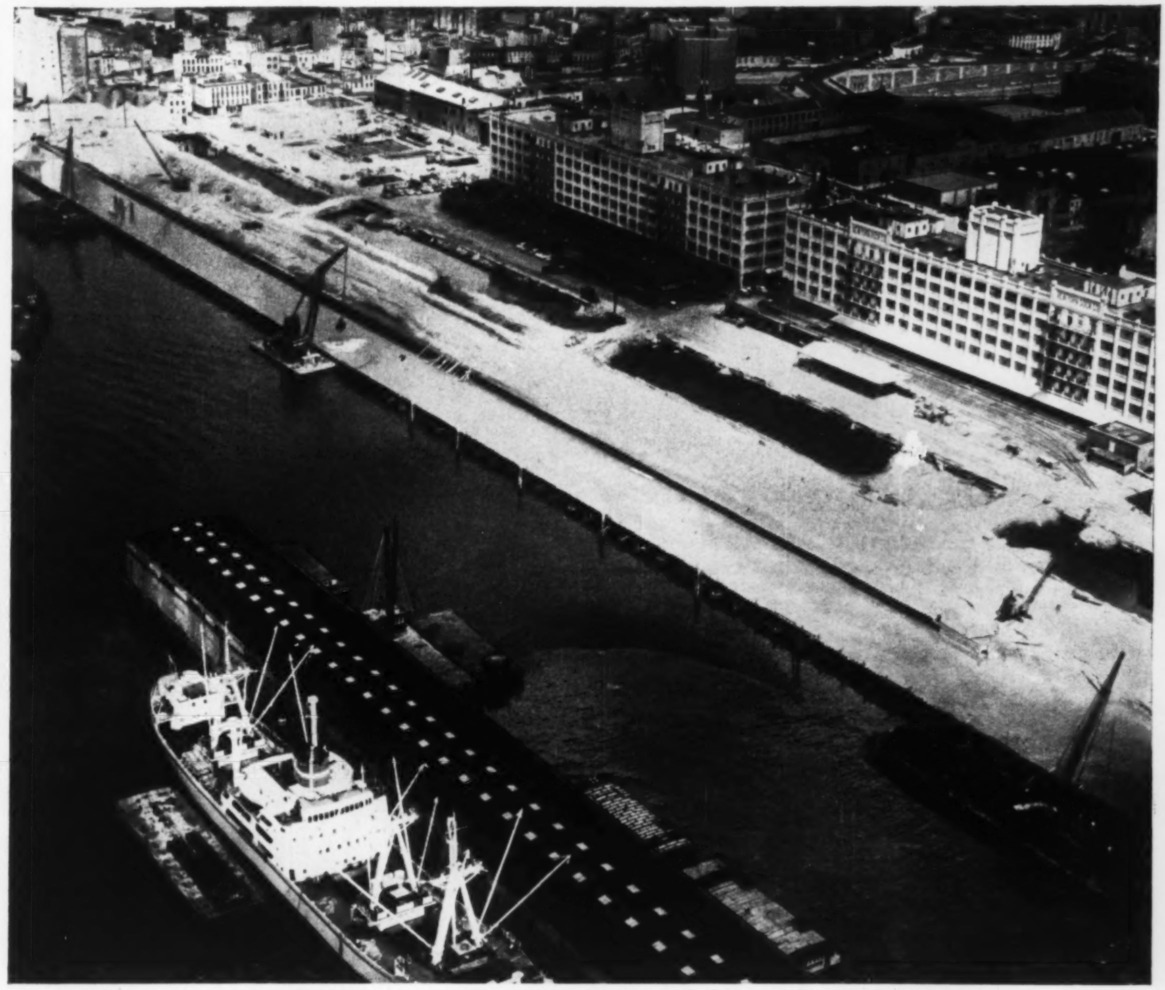
Monroe Calculating Machine Co., Inc.
National Pool Equipment Company
Portland Cement Association
Prehy Company
Raymond Concrete Pile Company
Royal McBee Corporation
Servicised Products Corporation
Sika Chemical Corporation
Soiltest, Inc.
Sonoco Products Company
Spencer, White & Prentis
Sprague & Henwood, Inc.
Tellurometer, Inc.
TESTlab Corporation
The Texas Company
United States Steel Corporation and the American Bridge Division of USS
Water Seals, Inc.
Wild Heerbrugg Instruments, Inc.



LONGEST WHARF IN NEW YORK HARBOR
built with Sheet-Piling Bulkhead and Anchor Wall

New York City's largest single waterfront facility is new Pier 11 in Atlantic Basin, Brooklyn-Port Authority Piers, completed in April. It provides 2100 ft of marginal berthing space, five acres of truckloading space, plus cargo building and loading platforms.

Pier 11 was constructed by the solid fill method, using a rock dike and steel sheet piling at the waterside. A second-sheet pile wall was driven to serve as a "deadman" anchor, and special-length tie rods firmly connected anchor and sea walls.

Bethlehem supplied 3900 tons of steel sheet piling for Pier 11, and also supplied the special-length tie rods.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

Bethlehem supplied 3900 tons of sheet piling for Pier 11, and also supplied the special-length tie rods.

BETHLEHEM STEEL

BETHLEHEM STEEL

EQUIPMENT, MATERIALS and METHODS

(continued)

Oxygen Plant

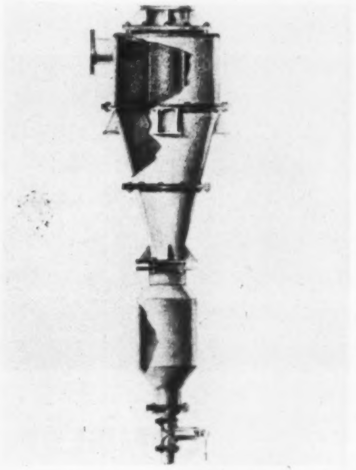
JONES & LAUGHLIN'S NEW Basic Oxygen Process installed at the companies Aliquippa Works employs, as its principal utility, the latest advance in oxygen generating equipment, which is required for supplying the heavy oxygen needs of the new process. Two identical plants, plus 6,500,000-cu ft of oxygen in storage, are used to eliminate possibility of oxygen failure. Unusual features include a technical break-through in achieving low power consumption simultaneously with the extremely high reliability factor required by the steel industry.

Supplying oxygen to the new steel making process exactly as needed is no simple matter, for high pressures, cyclic demand and the need for complete safety and reliability of supply combine to complicate the problem. The new plants meet these problems by delivering a combination of high pressure gas and liquid oxygen. **Air Products, Inc., CE-9, P.O. Box 538, Allentown, Pa.**

Desanding System

THE DORRCLONE DESANDING SYSTEM for the removal of sand from water supplies provides an inexpensive method of continuously eliminating highly abrasive fine sand and silt from distribution mains and their components.

The complete system comprises a classifier with attached underflow chamber and attendant piping and supports. The unit, in which sand removal is affected, is a wet cyclone, rubber lined and cylindro-conical in shape. In all units the rubber lining is replaceable and depending upon cyclone size, the liner may be either molded exactly to the shape of the body or vulcanized in place. Choice of the size of the cyclone, available in diameters of 6, 12 or 24 in., depends primarily upon capacity requirements and flow variations.



Extremely Economical

In operation, sand-bearing raw water enters the cyclone tangentially and is subjected to centrifugal forces within the unit. These forces throw sand particles outwardly to the walls which serve to guide sand down the cone and into the underflow or collection chamber. This is drained periodically, either automatically or manually. Desanded water, in the meantime, overflows the top of the cyclone. **Dorr-Oliver Inc., CE-9, Havemeyer Lane, Stamford, Conn.**

a progress report –

Glen Canyon Dam Project to open vast new area

Work on huge Upper Colorado River Project well under way

When completed some six years hence, the giant Glen Canyon Dam, Reservoir and Powerplant Project will unlock the riches of a vast, 10,000-square-mile area.

The high concrete gravity arch dam, rising 700 feet from bedrock, will contain 5,493,000 cubic yards of concrete. Power from the 900,000 KW power plant, located 470' downstream from the dam, will make possible the development of huge resources of fuel, oil, minerals—including uranium—and timber.

When filled to capacity the 28,000,000-acre-foot reservoir will stretch 186 miles up the Colorado and 71 miles up the San Juan, a major tributary of the Colorado. Basically, this project is for river control and power generation.

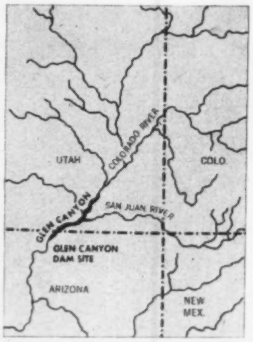
Largest single dam contract on record

The $107,155,222 contract for the Glen Canyon Dam and Powerplant, largest ever awarded by the U.S. Bureau of Reclamation, went to Merritt-Chapman & Scott Corporation, New York. On April 29, 1957, the day the contract was awarded, Merritt-Chapman & Scott signed a contract with Fairchild for aerial mapping of the dam site, reservoir and areas adjacent to the dam site. Flying operations began on May 5, *just six days later!* Advance copies of the flying results were delivered on May 26. Other detailed data followed soon after.

Scale of maps for Glen Canyon

Reservoir: 1" equals 400', 10' contours
Dam site: 1" equals 50', 2' contours
Areas adjacent to dam site: 1" equals 200', 5' contours

During the past 34 years, Fairchild crews have flown similar mapping assignments all over the free world. Results produced from this experience have led thousands of Fairchild clients to say... if you want it done *fast* and *right the first time*, you can depend on Fairchild.



Site of the 700' Glen Canyon Dam, second in height only to Hoover Dam (726') is located 12 miles downstream from the Arizona-Utah border—370 miles upstream from Hoover Dam.

Walls of the canyon at the dam site are 650' high with overhang in places. This necessitated flight paths parallel to the walls but offset to see under the overhangs.

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Highway planning and design level thinking should not only be based on the initial cost of new highways, but on the over-all lifetime costs. In fact, we should be sure we are not being "penny wise" and "pound foolish" by looking only at initial costs, but let's build highways that will provide a greater and more economical service lifetime. Plan now, at the design level, to reduce these massive yearly maintenance costs by designing modern, properly jointed highways that will provide maximum service with a minimum maintenance expense. Remember, every saving realized through reduced maintenance, will provide added miles of highways for the same expenditure of public funds.

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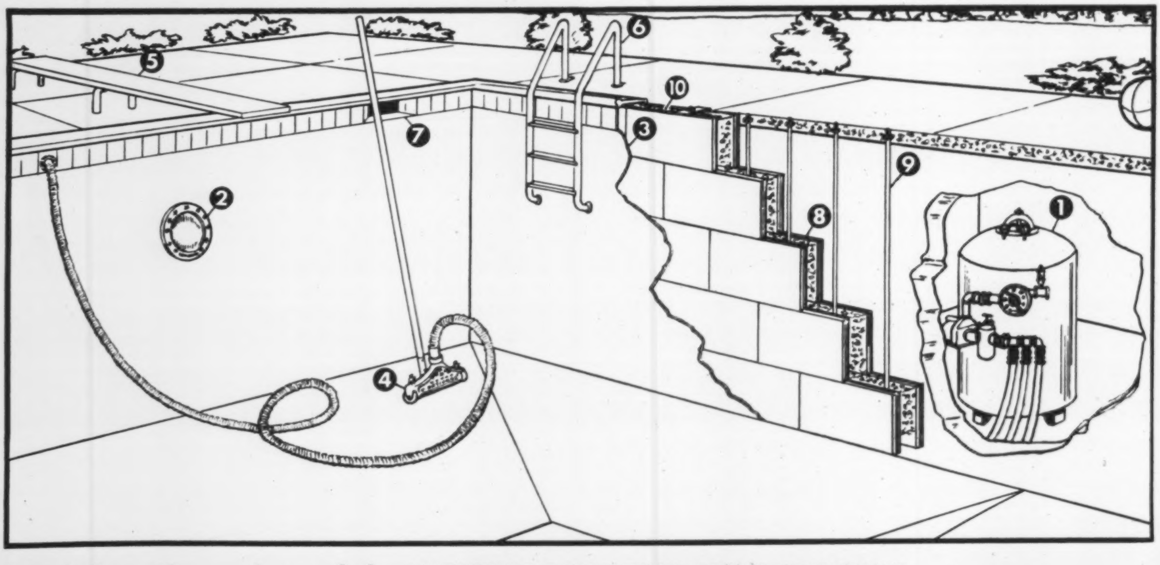

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EQUIPMENT MATERIALS and METHODS

(continued)

Rubber Product For Roads

Now made available is a free-flowing, devulcanized rubber specially prepared to be used in combination with asphalt for highway and general paving applications. Called Ramflex, it has proven itself to impart increased structural stability to asphaltic type pavements. While ideal as a surface course for new pavements, it is also equally suitable in providing a tighter, longer lasting hot patch for crumbled pavements. In cold weather, it reduces the brittleness and increases the impact resistance of asphalt concrete, thereby improving the load-carrying capacity of the surface. In hot weather, this rubber material will reduce the softness of a pavement, thus reducing displacement or "shoving." Because a rubber-asphalt combination has less tendency to flow, "bleeding" at high temperatures is minimized. Under all temperature conditions the adhesion of the asphalt to the aggregate is improved. This low-cost material can be added directly to the aggregate in pug mills without the necessity of specialized equipment. Its further versatility permits application in a conventional spreader without gumming the mechanism and permits closer rolling to the spreader, resulting in better compaction. **U.S. Rubber Reclaiming Co., Inc., CE-9, P. O. Box 365, Buffalo 5, New York.**

Curve Crown Pullley

An absolutely round-rimmed pulley with a single seam, 100% welded on both the outside and inside for maximum strength, the Curve Crown Pulley is produced under a completely new forming process. The crown is accurately formed on the outer ends of the rim, providing maximum training effect but eliminating belt stretch and wear, usually prevalent with the conventionl high-centered taper crown.

In all pulleys, the critical load carrying point is the hub. Weldments between the hub and the pulley end plate have proven detrimental because of stress concentrations. Bolting can cause distortion by excessive pulling on the bolts. To limit this, bolt sizes are kept to a minimum, resulting in the breakage of bolts or ineffective locking. The new Squeeze-Lock Hub circumvents all these drawbacks by exerting equal locking forces in two directions—to both shaft and pulley end plates—through a self-contained hub. These locking forces are developed by the drawing together of two hub end plates through the four heavy-duty, high-strength bolts which are completely independent of the pulley end plates. **Stephens-Adamson Mfg. Co., CE-9, Ridgeway Ave., Aurora, Ill.**

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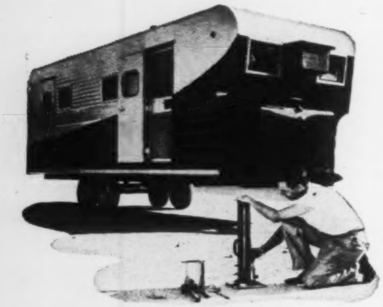

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EQUIPMENT MATERIALS and METHODS

(continued)

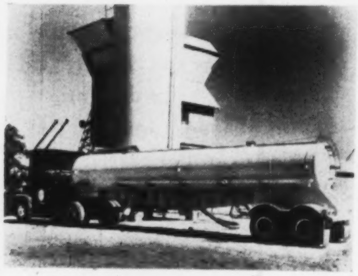
Grapple-Fork Attachment

A TOUGH, NEW HYDRAULIC Grapple-Fork attachment for the heavy-duty, fully hydraulic Versa-Lift truck mounted crane has been announced. The jaws of the fork open to 7-ft, between the points, and overlap when closed, leaving an opening 24-in. wide by 26-in. high between the jaws. Two spring-loaded "take-up" reels keep slack out of double wire-braid hose and heavy duty swivel prevents load turning unless desired. The Versa-Lift "400" crane mounts on any truck from 1½-tons up in just 22½-in. of space. With addition of the grapple-fork, it quickly and easily handles logs, poles, or any similar material. **Teale & Co., CE-9, Box 308, Omaha, Neb.**

Weatherproof Tank-Truck

IMPORTANT ECONOMIES IN THE weatherproof shipment of loose dry cement and pulverized products were promised by the introduction of a new pressurized tank-truck transport that carries dry bulk materials from producer to dealer or major user.

The vehicle is equipped with a low-pressure blower which automatically forces bulk cement or other pulverized cargo up into storage silos or batch plants through a 4-in. dia rubber hose, thus eliminating the need for standard-type bucket, belt, screw or other auxiliary handling mechanisms at the unloading sites.



Automatic Unloading

The truck's pneumatic delivery enables bulk loads of cement and other dry powdered materials to be delivered from vehicle to storage or batching units without risk of water contamination and spoilage which might occur as a result of unsheltered handling during inclement weather.

Still further economies are achieved

(*Continued on page 145*)

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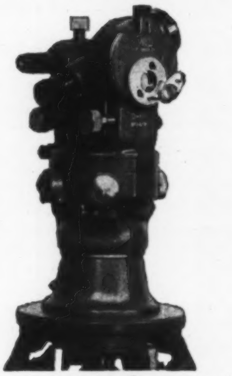

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EQUIPMENT MATERIALS and METHODS

(continued)

as a result of the automatic unloading feature of the transport. Opening a single valve on the truck begins cement flowing into storage or batch plants at rates up to 200 barrels or more per hour.

Air for the transport is supplied either by a power-takeoff driven blower on the tractor or from an independently driven blower unit. Air from the blower enters the tank through a 3-in. flexible hose mounted near the front end.

Materials may be pumped from the trailer directly to the top of the storage silos through a 4-in. hose or a short hose may be used to connect the unit to a 4-in. pipe, permanently mounted on the silos. Effective pumping range is approximately 150 ft in any direction from the discharge control valve at the center of the trailer. **Delta Tank Manufacturing Co., Inc., CE-9, Baton Rouge, La.**

The Chronomat

This combination chronograph and slide rule can be utilized in an infinite number of ways by men in all walks of life. Engineers, architects, sportsmen, business men, and professionals have been amazed to find that they can wear an instrument on their wrist which performs all the calculations of their work, such as multiplication, division, ratios, exchange, conversion, interest, and percentages.

The Chronomat features an all-steel case, 17-jewel movement, 60-sec and 45-min registers, and deluxe hands and dial with raised silver figures for easy reading. **Wakmann Watch Co., Inc., CE-9, 15 W. 47th St., New York 36, N.Y.**

Service Truck

Built especially for off-highway field service, the new Fabco Fab 100 4x4 is designed to give greater traction, stability, maneuverability, and low maintenance. It features equal power and equal load for all wheels; 80-in. track and 61⅝-in. spring centers: 111-in. wheelbase for a 14-ft body as compared to a 160-in. wheelbase for ordinary 4x4's with the same 14-ft length body; 50% tighter turning radius due to the short wheelbase and a unique front drive axle joint with 35-deg turning angle; forward tilt hood for engine accessibility, unique front spring suspension in connection with the front driving axle which transmits full engine torque and has greater load capacity. The company also builds other off-highway trucks and trailers for specialized uses, such as agriculture, forestry, petroleum, mining, construction, and maintenance. **F.A.B. Manufacturing Co., CE-9, 1249 67th Street, Oakland, Calif.**

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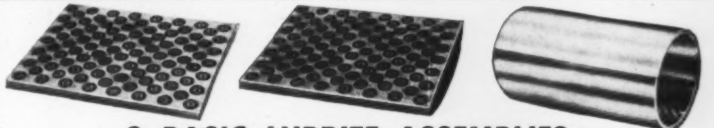

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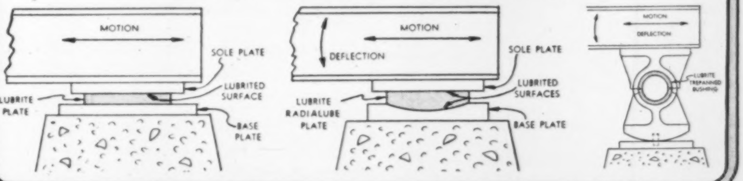

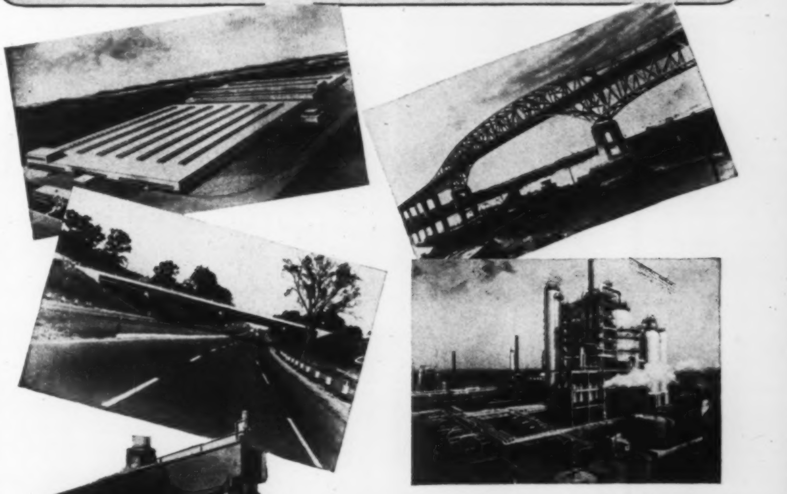

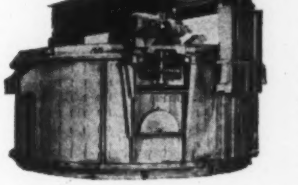

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EQUIPMENT, MATERIALS and METHODS

(continued)

Verifax Copier

A NEW OFFICE COPYING UNIT is expected to prove particularly useful to companies requiring copies of larger originals. Called the Verifax Viscount Copier, it can copy out-size legal documents, accounting forms, 10 by 16-in. automotive dealer financial forms and standard letter-size originals with equal ease.

Successor to the widely-used Verifax Copier, Legal Size, the Viscount has an improved paper feed assembly, a trimmer guide assembly for 10-in. paper, and makes the same photo-exact copies characteristic of the Verifax copying method. In addition, it embodies an "automatic" timer which compensates for changes in electrical voltage. **Business Photo Methods, Eastman Kodak Co., CE-9, Rochester 4, N.Y.**

Lightweight Diaphragm Pump

KNOWN AS THE MODEL 302B, the new pump weighs only 126-lb in a base-mounted unit and 137-lb as a wheel-mounted unit. The wheel-mounted pump can be handled easily by one man, while two carry handles balance the load on the base-mounted pump and make it easy to carry. The new lightweight "Mud-Hog" features an aluminum Briggs & Stratton four-cycle engine with a recoil starter for true portability and long service life. It has a crank-type drive with heavy-duty, heat treated gears running in an oil bath. The pump body is also of sturdy, shock-resistant aluminum that keeps weight to a minimum. Air chambers on the pump suction and discharge reduce surges and make operation smoother. Heavy duty valves give long, maintenance-free service life. Suction and discharge pipe nipples are steel for long thread life. **Marlow Pumps, CE-9, Midland Park, New Jersey.**

Trans-Adhesive Impression

A NEW HEAT-RESISTANT adhesive that holds all typographic detail firmly in place at high temperatures has been developed. Called the HR-Heat Resisting Trans-Adhesive Impression, it is a precision proof of the desired material, printed on clear or mat finish acetate. Almost any symbol, word or charting detail required is provided in the large selection of type styles and symbols.

According to the company, sharp detail is assured by the use of precision printing equipment. The impressions are printed on both sides of the acetate in perfect register to assure opacity. No heat is required to apply them; they are burnished down with a cold burnishing tool. **Monsen Typographers, Inc., CE-9, 22 E. Illinois St., Chicago 11, Ill.**

Steel Pipe

THIRTY-NINE STEEL CYLINDERS form the air storage receiver of Republic Aviation Corporation's new wind tunnels. The expense of one large high-pressure vessel has been eliminated by using 22-ft long sections of high strength pipe—an "off-the-shelf" item. Pipe ends were formed by swaging; cylinders were then welded to a common header system. Pump-up pressure in the cylinders is 3000-psig—enough for tests ranging from 40-sec to over 3-min. at four times the speed of sound. Air temperature may not vary by more than 60-F from start to finish of

(*Continued on page 147*)

HOW LONG IS A LONGSPAN JOIST?

The longest structural steel joist made is a 150 foot T-Chord* Longspan Joist produced exclusively by Haven-Busch Company. While most other joists run less than 100 feet in length, Haven-Busch makes this extra long joist (half the length of a football field) to give architects and builders greater leeway in planning large clearspan, column-free interiors for such buildings as a bowling alley, fieldhouse, gymnasium or auditorium.
It is because of products such as this 150 foot long joist — and the men who make it — *that better building begins with steel by Haven-Busch.*

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*T.M. Reg.

AISC

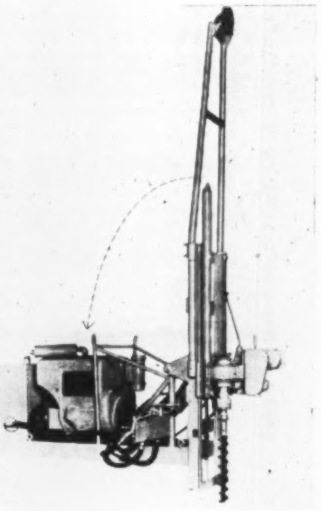
EQUIPMENT MATERIALS and METHODS

(continued)

any test. Because of expansion, the air leaving the cylinders tends to cool. To counteract this and the Joule-Thompson cooling effect through the throttling valves, crimped steel plates having a relatively large heat storage capacity have been inserted into the lower third of each cylinder. In passing the plates, the air absorbs some of this heat so that test temperatures are kept within design limits. **Burns & Roe, Inc., CE-9, 160 W. Broadway, New York 13, New York.**

Lightweight, Versatile Drill

CALLED THE B-40 EXPLORER, this unit is used for continuous flight augering to 75 ft, for coring to 500 ft and for boring holes up to 24 in. in dia. It is ideally suited to soil sampling, both disturbed and undisturbed, and is quickly convertible from one type of drilling to another.

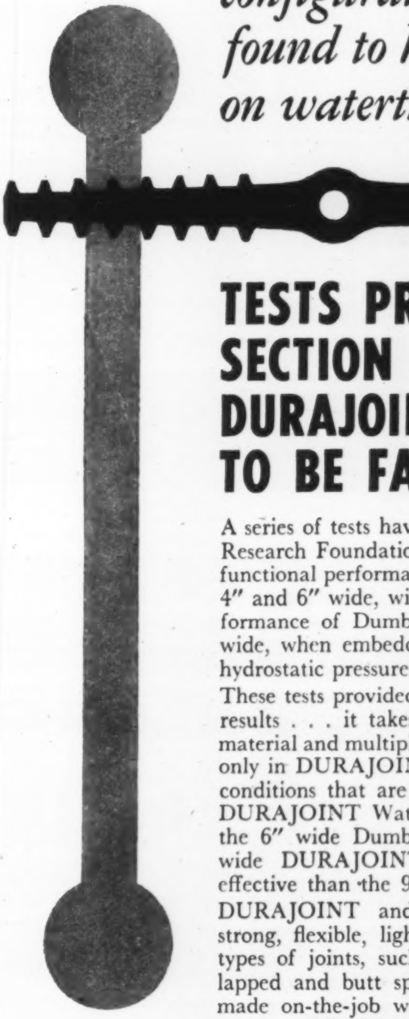


One-Man Operation

Self-powered by a 4-cyl, 36-hp air-cooled engine, the drill is also available without engine for mounting on any PTO-equipped truck, barge or tractor. Compact size permits installation on ½-ton carriers. Mounting dimensions for drill assembly are: length 37½ in., width 26½ in., height 55 in. (tower down) and 86¼ in. (tower up); for power assembly: length 45½ in., width 26½ in., height 40 in.

The PTO model weighs only 1400 lb, making the Explorer especially advantageous in locations which are inaccessible to larger, heavier drills. To increase

(*Continued on page 148*)



"Cross-Sectional configurations have been found to have an influence on watertightness" *

TESTS PROVE CROSS-SECTION DESIGN OF DURAJOINT WATERSTOP TO BE FAR SUPERIOR!

A series of tests have been conducted by the Ontario Research Foundation in order to determine how the functional performance of DURAJOINT Waterstops, 4″ and 6″ wide, will compare to the functional performance of Dumbell Type Waterstops, 6″ and 9″ wide, when embedded in concrete and subjected to hydrostatic pressures of various magnitudes.

These tests provided many interesting and important results . . . it takes the right combination of PVC material and multiple-ridge cross-section design, found only in DURAJOINT, to stop water under all joint conditions that are likely to exist . . . the 4″ wide DURAJOINT Waterstop is far more effective than the 6″ wide Dumbell Type Waterstop and the 6″ wide DURAJOINT Waterstop is also far more effective than the 9″ Dumbell Type Waterstop.

DURAJOINT and DURASEAL Waterstops are strong, flexible, lightweight, easy to install . . . all types of joints, such as tee, box, cross-joints, overlapped and butt splices may be quickly and easily made on-the-job without the use of special equipment or skilled labor.

Be sure to investigate these interesting results yourself . . . just mail the coupon (below) today, for your free copy of Technical Report No. 4 that contains complete technical data, as to how the performances of waterstops compare, plus actual copies of the test reports. If you are interested in watertight waterstops, this report should prove to be one of the most interesting technical manuals you've ever read.

* Journal of American Concrete Institute, Discussion 52-7, V. 28, No. 6, Dec. 1956, Part II, Proceedings V. 52, Page 1151

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STANPAT SOLVES THE GHOSTING PROBLEM

NEW resin-base STANPAT ELIMINATES GHOSTING, offers better adhesion qualities on specific drafting papers!

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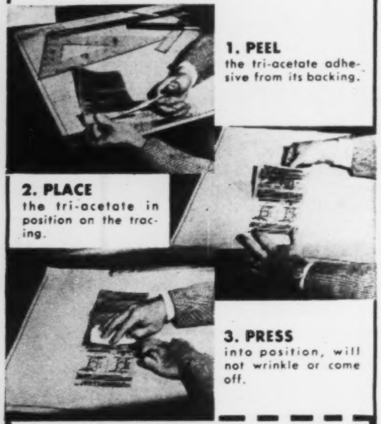
Some of our longtime customers first called our attention to the "ghosting" problem. Certain tracing papers contain an oil which could be leeched out by the STANPAT adhesive (green back) causing a ghost.

THE SOLUTION
A new STANPAT was developed (red back), utilizing a resin base which did not disturb the oils and eliminates the ghost. However, for many specific drafting papers where there is no ghosting problem, the original (green back) STANPAT is still preferred.

WHICH ONE IS BEST FOR YOU?
Send samples of your drawing paper and we will help you specify. Remember, STANPAT is the remarkable tri-acetate pre-printed with your standard and repetitive blueprint items—designed to save you hundreds of hours of expensive drafting time.

SO SIMPLE TO USE



1. PEEL the tri-acetate adhesive from its backing.

2. PLACE the tri-acetate in position on the tracing.

3. PRESS into position, will not wrinkle or come off.

STANPAT CO.
WHITESTONE 57, N. Y., Dept. 46
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STANPAT CO. Whitestone 57, N. Y. U.S.A.

☐ Enclosed are samples of the drafting paper(s) I use (identify manufacturer). Please specify whether Rubber Base or Resin Base STANPAT is most compatible with these samples.

☐ Send literature and samples of STANPAT.

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EQUIPMENT MATERIALS and METHODS

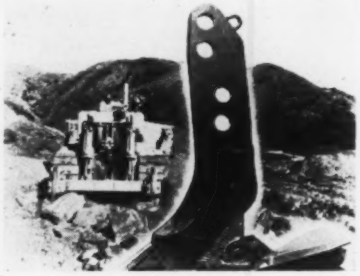
(continued)

mobility, both tower and drill frame lower to horizontal position, thus permitting drilling at any angle from vertical to horizontal.

Hydraulic drive delivers high torque to assure positive augering action. Drilling speed ranges from 62 to 500 rpm with maximum torque output of 1740 ft lb. Sixty-eight inch stroke is actuated by powerful hydraulic cylinder exerting 7069-lb lift pressure, 6283-lb ram pressure. The rate of free feed is 35.3 fpm. Centralized controls permit one-man operation. **Mobile Drilling, Inc., CE-9, Dept. 31, 960 N. Pennsylvania St., Indianapolis, Ind.**

Ripping Tool

One of the unique features of this new heavy duty ripping tool is its breaker plate, a heat-treated steel wedge 22-in. wide, weighing about 140 lb, and attached to the rear of the shank in a horizontal position. This plate works on the same principle as a log-splitting wedge, in this case greatly expanding the fractures in the stratum to the right and left of the shank and in front of the ripper point, at the same time lifting ripped material upward.

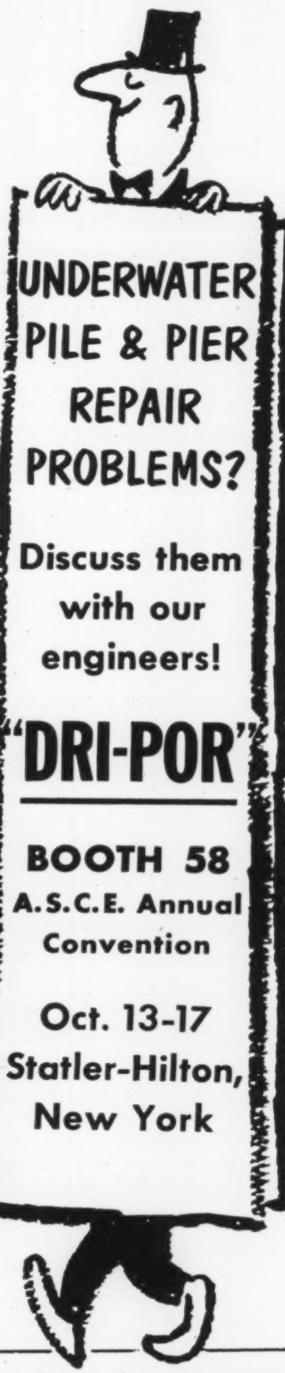


Heavy Duty

This action relieves pressure on the point as it forges ahead through virgin strata; pulls the shank into the ground to its full depth below the ripper bar and holds it there; prevents frequent ride out of the shank in tough going; permits tractor ripping without pre-shooting in many hard formations that ordinarily required blasting prior to ripping. All this results in smoother, more efficient ripping and less fatigue for the tractor and the operator.

The breaker plate's riding angle is job-engineered and controlled by an adjustable shoe mounted on the bottom of the plate. Adjustment is made by a standard bolt and nut. The tool, 950 lb

(*Continued on page 149*)



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EQUIPMENT MATERIALS and METHODS

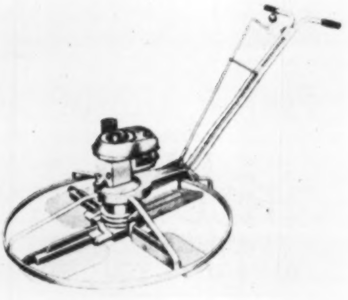
(continued)

of heat-treated billet steel, operates from the tractor ripper bar.

Applications include heavy construction, logging, and mining. Rugged formations which the tool has ripped effectively are decomposed granite, shale, conglomerate, sandstone, hard-pan, laminated schist, and quartzite. **Double J. Breaker Co., Inc., Construction Equipment Div., CE-9, 3484 East Gage Ave., Bell (Los Angeles) Calif.**

Cement Finisher

Known as the Lo-Boy, this cement finishing troweling machine has an exclusive offset design of tangential arm mountings which equalize the weight on the blade surfaces, thus putting more support of the machine onto the center of the blade for longer equipment life and a more even surface. A large control handle close to the operator's hand allows easier blade tilting from float to finish; as the concrete hardens, the operator can tilt the trailing edge of the blade down for the breakoff and the finish.


Mercury Safety Switch

The machine's mercury safety switch prevents injury to the operator and damage to the job and the machine. If the blade hits any obstruction while troweling under power, the resultant action usually produces a violent twist of the handle which has injured operators in the past. On the Lo-Boy, the mercury switch located in the handle kills the motor in only ¼ revolution; thrown outward by centrifugal force, it automatically shuts off the current.

The four arms are constructed of heavy cast iron to assure that no distortion can ever take place and that blades are completely in place at all times. The stationary guard ring rides the wall to within ⅜ in., thus eliminating the danger of a moving ring hitting the wall and tilting the machine. The motor itself

(Continued on page 150)

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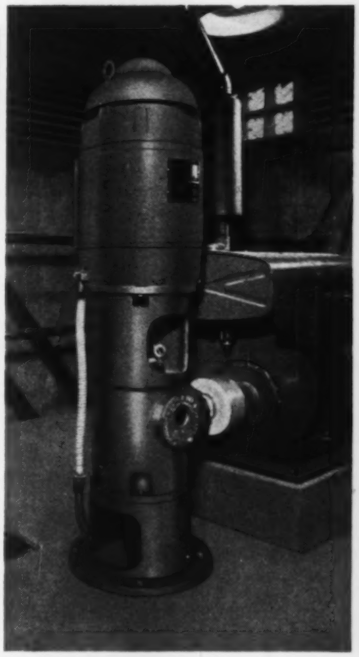

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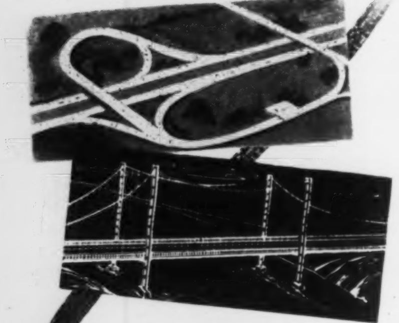

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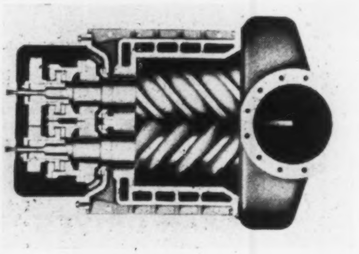
has an additional safety feature, for it idles when started and the blades cut in only when 1800-rpm is reached. The operator may safely adjust the trowel in stationary position without shutting off the power. **Dart Manufacturing & Sales Co., CE-9, 1002 South Jason Street, Denver 23, Colo.**

Rotary Compressor

A NEW LINE OF POSITIVE-displacement rotary compressors that rival the efficiency and stability of reciprocating machines while matching the compactness and low maintenance of centrifugals has been announced.

Designed for continuous heavy-duty industrial service handling air, gas or vapor, the compressor has a standard capacity range of 800 to 13,000 cfm, and is expected to have wide application in the process industries for both pressure and vacuum systems including industrial and instrument air, refrigeration, gas and vapor recycling, and production of acids.



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The compressor is a two-impeller, helical-lobe type, axial-flow, rotary machine with four-lobe power impeller and a secondary impeller with six matching gaps synchronized by timing gears. The impellers rotate with a pure rolling motion and power is transmitted to the secondary impeller through the cushion of compressed gas. There is never any metal-to-metal contact between impellers or with the surrounding casing, making it unnecessary to lubricate the impellers. There can be, therefore, no lubricant contamination of the product and completely oil-free air, gas or vapor is assured. Maintenance is low since there are no valves or pistons to wear.

As the impellers rotate, the lobes and matching gaps part on the intake end creating an intake suction comparable to the suction stroke of a reciprocating pis-

(*Continued on page 151*)

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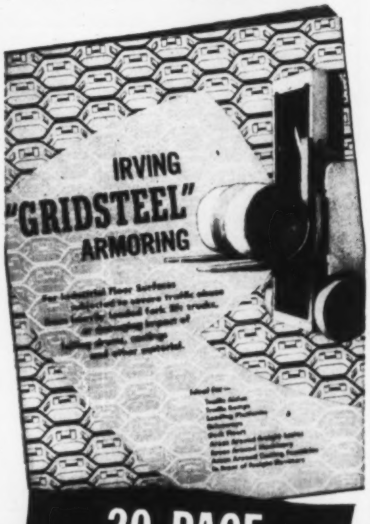

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ton. Further rotation isolates the interlobal space from the intake and the intermeshing lobes reduce the volume and compress the gas. As the leading edges of the lobes pass the stationary edges of the discharge opening, the compressed gas is forced into the discharge line. The interlobal space is reduced to zero before passing the discharge opening, eliminating pockets and gas carry-over. The flow of compressed gas is virtually continuous and pulsation and vibration are kept to an absolute minimum. **Fairbanks, Morse & Co., CE-9, Chicago 5, Ill.**

Reinforced Epoxy Pipe

CORROSION-RESISTANT REINFORCED plastic pipe, strong as steel but only one-eighth the weight, is now being manufacture! in 2 to 12-in. dia to meet piping, tubing and ducting needs in the building field. The manufacturer uses a patented process employing interwoven fiber glass filaments, impregnated with epoxy resins and heat cured. Known as Bondstrand, the pipe comes in rigid 20-ft lengths with ends plain, bell-and-spigot or flanged. Other lengths, as well as diameters up to 40-in., are available on special order. The pipe is nontoxic, nonflammable and collapse-resistant, and does not cold flow or sag in use. It may be used for most petroleum and chemical products; sewage and industrial wastes and gases; fresh and salt water, foods and pharmaceuticals; and as structural tubing and conduit. Its smooth, friction-free interior surface resists scale and paraffin deposits, assuring full rate of flow for the life of the pipe. **Amercoat Corporation, CE-9, South Gate, Calif.**

Activated Densifier

KNOWN AS "DENSICON 76", this material is reputed to protect concrete floor surfaces against chemical damage and "dusting" while increasing resistance to traffic wear. It is flowed on in liquid form with a long-handled brush. It is said to penetrate deeply into capillaries of the surface and then crystallize to assure structural density. The manufacturer states density provided by two applications, 24 hours apart, is equivalent to that of three coatings with concrete hardeners. Also, Densicon-treated surfaces are claimed to breathe and permit water vapor transmission. The latter is very important to on-grade floors. The material is said to prevent chemical attacks on concrete by vegetable and animal oils, coal tar distillates and dilute water solutions. It reduces absorption and deep staining of oils and greases. **Maintenance Inc., CE-9, Wooster, Ohio.**

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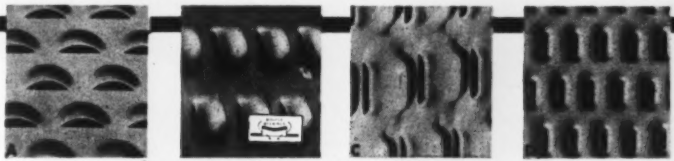

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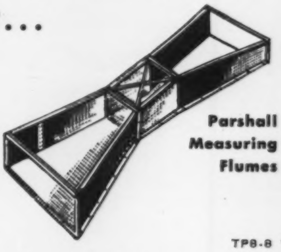

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Literature Available

Soil Cement Stabilization—Entitled "ABC's of Soil-Cement Stabilization," this colorful 36-page brochure is a fully illustrated, easy to read treatment of every practical aspect of soil cement stabilization, as related to street, highway, super-highway, and airport construction. Some of the questions answered and illustrated with helpful charts and typical job examples are: What is soil cement? Where is it used? How is it best processed? What are the best operational procedures? **Pettibone Mulliken Corp., CE-9, 4700 W. Division St., Chicago 51, Ill.**

Tractor Shovel—In this 6-page, highly illustrated brochure, the exclusive features that make the Model 404 tractor shovel operate efficiently and economically in sand and gravel, quarry, coal stripping and snow removal operations are described in detail, such as: the straight line horizontal thrust which starts the push of the operating arms from the rear of the machine and continues it through the body of the machine to the cutting edge of the bucket; the reverse curve safety arms which give full 360-deg vision and are below the level of the operator even when the bucket is fully raised; and high traction differential which overcomes torque loss from wheel slippage. **The Yale & Towne Manufacturing Co., Contractors Machinery Div., CE-9, Batavia, N.Y.**

Bituminous Distributor—A new four-page brochure discusses the Bituminous Distributor which is available side mounted, rear mounted, and in semi-trailer forms with a capacity of 1000 to 1430-gal. The most important feature described in the booklet is the ability of the unit to provide full-on starts and a clean cutoff. The full-on starts are provided by the exclusive 24-ft Cartwright hot spray bar, which is fed at 12 points, thus, forcing circulation through the full length of the bar resulting in positive pressure at the nozzles and assuring full on starts. Shut-off is made at the nozzle, eliminating dripping and providing a clean straight cut-off. **City Tank Corp., CE-9, 53-09 97th Place, Corona 58, N.Y.**

Flexible Couplings—An 8-page, letterhead-size, two-color bulletin tells how to select new "Sure-Flex" couplings suited to more than 150 different service applications. Five tables short-cut the usual engineering calculations and give the right answer in a matter of seconds, taking into consideration the type of driver, hp and rpm as well as the specific application. This coupling consists of two flanges and a two-piece rubber sleeve, which lock together without clamps or screws. **T.B. Wood's Sons Co., CE-9, Chambersburg, Pa.**

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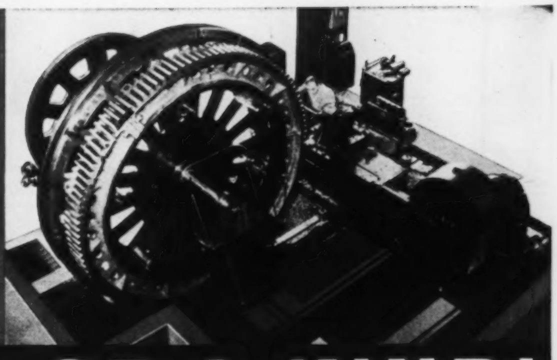
Literature Available

IMMERSIBLE MOTOR—A 4-page bulletin, No. 2300, has been published on the Immersible Motor which is designed for submerged operation. The booklet describes applications in which the motor is close-coupled to pumps, agitators and mixers, thus eliminating lengthy shaft connections, intermediate bearings, couplings and special bases. Illustrations and a cutaway drawing show engineering features which suit the motor to operation in water, chemicals, abrasive industrial oils and sewage sumps. **The Louis Allis Co., CE-9, 427 E. Stewart St., Milwaukee 1, Wis.**

VIBRO-ISOLATORS—A completely new catalog, Bulletin K3B, giving all the latest data on stopping vibration, shock and noise transmission by using steel spring machinery mountings has been published. It explains clearly the reasons for using springs in controlling vibration, and describes the series L Vibro-Isolators. Eight typical case histories, complete with installation photos, show how these machinery mountings solved a representative range of vibration and shock problems. For the first time, costs of highest efficiency vibration and shock isolation are given, enabling the plant engineer, consulting engineer, and contractor to approximate the cost of installing machines on resilient mountings. **The Korfund Co., Inc., CE-9, 48-23B 32nd Place, Long Island City 1, N.Y.**

RUBBER PRODUCTS—Designed to serve as a complete reference for busy construction men, this 8-page catalog includes 26 types of hose and 4 types of conveyor belting. Information is given on each product's application, construction, lengths and sizes. Also listed are working pressures, weights and plies. Hose applications are: water handling, suction, steam handling, pile driving, cement handling, sand blasting, welding and dredging. **Hamilton Rubber Manufacturing Corp., CE-9, Trenton 3, N. J.**

QUICK COUPLING METHOD—A new 6-page 2-color illustrated bulletin describing the "Vic-Easy" method of quick-coupling lightweight pipe or tubing has been prepared. The brochure details installation and operating features, explains how the use of lightweight pipe with roll-grooved ends effects substantial savings, and illustrates typical applications in oil fields, mining and construction. Drawings show how the couplings lock the grooved pipe ends to form a positive, leak-tight seal under pressure or vacuum and how the design permits quick disassembly for reuse, or removal of individual pipe lengths for cleanout, repair or replacement without disturbing adjoining sections. **Victaulic Company of America, CE-9, P.O. Box 509, Elizabeth, New Jersey.**



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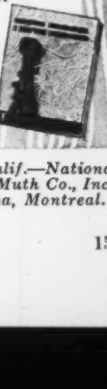

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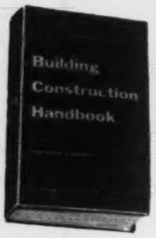

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"Float Your Troubles Away"—A movie showing the heavy media process for removing unsound or deleterious particles from gravel, is now available. Filmed in full color, the theory, operation, and results obtainable in producing premium aggregate by the HMS process are shown. This movie is an invaluable guide to the gravel producer desiring to know whether HMS can help him produce the quality product required by today's higher concrete specifications. **Western Machinery Co., CE-9, 650 Fifth St., San Francisco 7, Calif.**

Aluminum Welding—Techniques that make welding of aluminum simple and practical are demonstrated in a new 33-min full-color sound movie entitled "Aluminum Welding . . . Different, Not Difficult." The movie shows that aluminum is easy to join by welding, brazing or soldering, although the techniques are different from those used with other metals. Animation is used to help make the technical presentation simple and interesting. **Reynolds Metals Co., Advertising Distribution Center, CE-9, Richmond 18, Virginia.**

Rotary Drills—A new 16-mm sound film in color, showing operations of the Model M8 Rotary Drills, has been produced. Approximately 20 min in length, the film shows the drills working in strip mines, quarries, highway construction jobs and in water well drilling. They are manufactured in nine models with rated capacities to 3,500 ft. **Davey Compressor Co., CE-9, Kent, Ohio.**

"Span and Save"—An excellent understanding of current methods of applying Spanall, the new all-metal horizontal shoring for beam and slab concrete floor forms, may be obtained from this color and sound film. It depicts stripping methods as well as installation methods at building sites in various parts of the country. The film is available without cost for group showings to building and construction contractors, architects, societies, schools and colleges. **Spanall of the Americas, Inc., CE-9, 787 United Nations Plaza, New York 17, N. Y.**

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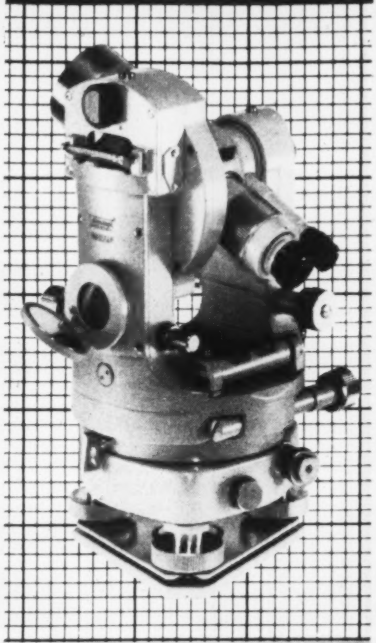

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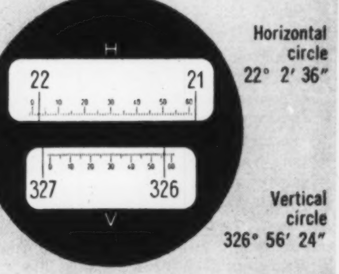

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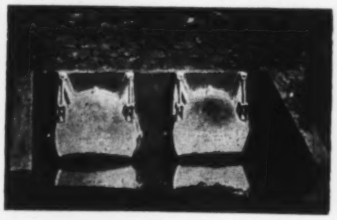

Fig. B-124-D
Two 60″ Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

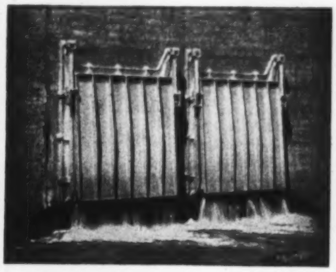

Fig. B-124-C
Two 72″ x 72″ Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

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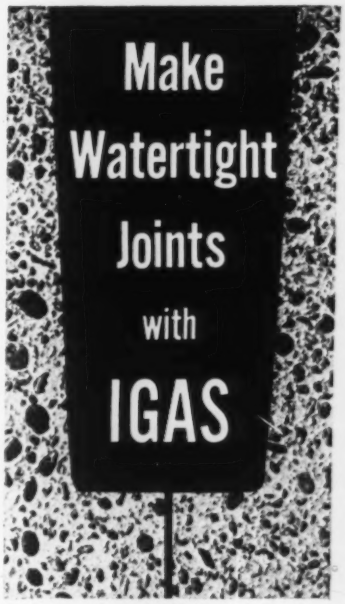
From the MANUFACTURERS

INCREASE NOTED: A leading producer of heavy industrial and mining equipment, Joy Manufacturing Co., has announced that the company has received $1,250,000 in Government orders for air and gas compressors, including those for high pressure air and gas compressors for Bomarc missile bases and for portable compressors to be used by the Corps of Engineers . . . **REPRESENTATIVE APPOINTED:** The Marion T. Davis Co. of Atlanta, Georgia, has been appointed exclusive Southern representative for agricultural and construction applications of polyethylene film by the Durethene Unit of Koppers Co., Inc. . . . **NEW LAND ACQUIRED:** To provide additional manufacturing capacity for the company's heavy machinery lines, Chain Belt Co., Milwaukee, Wis., has just acquired 92 acres of land in Madison, Indiana . . . **CONTRACTS AWARDED:** A contract for the construction of a new traveling coal unloading tower for the Montaup Electric Co. at Somerset, Mass., has been awarded to The Mead-Morrison Div. of the McKiernan-Terry Corp. at Harrison, N. J. . . . A contract for the fabrication and erection of exterior metal curtain wall and interior ornamental metal for the new United Air Lines terminal building in New York has been awarded to the Columbus Div. of North American Aviation, Inc. . . . **DISTRIBUTOR APPOINTED:** Dillon Supply Co., Raleigh, North Carolina, has been announced as authorized stocking distributors of the Asco Solenoid Valves, manufactured by Automatic Switch Co. . . . **PRODUCTION STARTED:** The second of five reduction pot lines at the Ormet Corp. aluminum reduction plant started routine production on schedule. Full scale operation at the $110,000,000 facility is scheduled for the end of the year . . . **CEMENT SHIPMENT:** The first carload of cement from its nearly completed plant at Lime Kiln, Md. has been shipped by Alpha Portland Cement Co., Easton, Pa. . . . **NEW SALES OFFICE:** A new sales office to cover the Eastern and Middle-Atlantic states has been opened at 120 Halsted St., East Orange, New Jersey, by Commercial Shearing & Stamping Co. . . . **DEALER APPOINTED:** The appointment of G. C. Phillips Tractor Co., Inc., Birmingham, Alabama, as the Buffalo-Springfield dealer for the state of Alabama and 10 counties in northwest Florida has been announced by Buffalo-Springfield Roller Co., Div. of Koehring Co., Springfield, Ohio . . . **APPOINTMENTS:** Pierce Crane Carrier Sales Co., Portland, Ore., has announced the appointment of Bob Fox of Van Nuys, Calif., to sell and distribute Crane Carriers . . . The election of Bernard G. Palitz as president, chairman of the board and treasurer, of Credit-America Corp., 500 Fifth Ave., N. Y., pioneers in financing the sale of machinery, has been announced.



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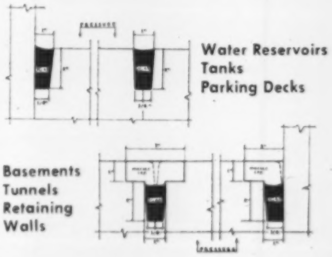

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AUGUST

Journals: Hydraulics, Power, Soil Mechanics and Foundations.

1725. Outlet Structures for Fixed-Dispersion Cone Valves, by Maurice L. Dickinson, Stanley M. Barnes and Robert S. Milmoe. (HY) Outlet structures housing fixed-dispersion cone valves at three locations with varying requirements for protection against freezing, energy dissipation, and dependable remote control with close regulation of discharge are described. Results of model and prototype tests are given.

1726. Hurricane Protection Planning in New England, by John B. McAleer and George E. Townsend. (HY) Hurricane Carol of August, 1954, triggered authorization of a hurricane survey of the Atlantic and Gulf Coasts. This paper describes the basic data and engineering methods used in the New England area.

1727. Predicting Seepage Under Dams on Multi-Layered Foundations, by Paul H. Shea and Harry E. Whitsett. (SM) This paper presents methods developed for predicting rates of seepage under dams and levees on multi-layered foundations. A description of the pumping test procedure used to implement those methods is included.

1728. Design and Performance of Vermillion Dam, by K. Terzaghi and T. M. Leps. (SM) Design and performance of a zoned earth dam on marginal glacial deposits is described. The deposits were so intricately stratified that determination of essential geological features had to be deferred until the construction period.

1729. Procedure for Rapid Consolidation Test, by Hsuan-Loh Su. (SM) A method for the consolidation test is given with precision of results comparable to that from a conventional test.

1730. Effects of Ground on Destructiveness of Large Earthquakes, by C. Martin Duke. (SM) Knowledge of the relation between ground conditions and earthquake damage to structures is presented in terms of observations of destructive earthquakes. Thirty-six earthquakes are cited for which a relation has been reported.

1731. Pressure Grouting Fine Fissures, by Thomas B. Kennedy. (SM) Fine horizontal cracks between concrete slabs were grouted in a laboratory study. It was found that certain materials, when added to grouts, greatly reduced their solubility.

1732. Geotechnical Properties of Glacial Lake Clays, by T. H. Wu. (SM) This paper describes properties of glacial lake clays. Data collected from the Great Lakes are are presented. The investigation consists of an evaluation of the stress history and structure of the clay deposits.

1733. Rockfill Dams: Cherry Valley Central Core Dam, by H. E. Lloyd. O. L. Moore and W. F. Getts. (PO) Construction and performance of the Cherry Valley Dam of the Hetch Hetchy Water Supply of the City and County of San Francisco is described. Measurements of the settlements and deflections are given.

1734. Rockfill Dams: Brownlee Sloping Core Dam, by Torald Mundal. (PO) This paper describes the design and construction of the rock-fill dam portion of Brownlee Hydroelectric Project, including diversion of flood waters over the partially completed embankment, and construction of the embankment on 110 feet of river-deposited materials.

1735. Rockfill Dams: Kajakai Central Core Dam, Afghanistan, by Glenn F. Sudman. (PO) This paper examines the design and construction of the rockfill dam embankment portion of Kajakai Project, that required maximum use of locally obtainable materials and training of a native work force.

1736. Rockfill Dams: Performance of TVA Central Core Dams, by George K. Leonard and Oliver H. Raine. (PO) Presented is a comparison between design assumptions that may influence that design of rockfill dams. Three TVA rockfill dams are considered in this light.

1737. Rockfill Dams: Salt Springs and Lower Bear River Concrete Face Dams, by I. C. Steel and J. B. Cooke. (PO) The 28-year service record of Salt Springs Dam is presented. The design, construction and performance of the two Lower Bear River Dams is presented and compared to that of Salt Springs Dam.

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1738. Rockfill Dams: The Dalles Closure Dam, by Robert J. Pope. (PO) The problem of a closure dam for the Dalles project in 180-foot depth of water was solved by the design and construction of a rockfill structure, two-thirds of which was built under water.

1739. Rockfill Dams: Review and Statistics, by John B. Snethlage, F. W. Scheidenhelm and Arthur N. Vanderlip. (PO) The paper reviews present practices on rockfill dams and develops a definition, classification and terminology for such dams and for those using earth in addition to rock fill. Advantages of deck-type dams and settlement and economy of rockfill dams are examined.

1740. Rockfill Dams: The Bersimis Sloping Core Dams, by F. W. Patterson and D. H. MacDonald. (PO) The Bersimis No. 1 hydroelectric power development in Canada involved the construction of two earthfill dams and two rockfill dams. This ~~paper~~ describes the site, design, construction, and performance of these dams.

1741. Rockfill Dams: The Derbendi Khan Dam, by Calvin V. Davis. (PO) Problems in designing a central core rockfill dam in Iraq are described. A field exploration and materials testing program provided a sound basis for the selection and design of the dam.

1742. Rockfill Dams: Nantahala Sloping Core Dams, by James P. Growdon. (PO) Design of a 250-foot high sloping core rockfill dam was determined to facilitate construction with materials readily available. This paper describes the site and examines construction procdures and performance.

1743. Rockfill Dams: Dams With Sloping Earth Cores, by James P. Growdon. (PO) This paper reviews the principles which govern the design of a rockfill dam and examines six rockfill dams.

1744. Rockfill Dams: Performance of Seven Sloping Core Dams, by James P. Crowdon. (PO) Design and construction of seven dams is briefly reviewed. Performance, measured in terms of leakage, repairs and maintenance is presented.

1745. Rockfill Dams: Performance of Mud Mountain Dam, by Allen S. Cary. (PO) Mud Mountain Dam, an earth and rockfill structure 400 feet high, has settled in the core zone as predicted during design studies based on large scale consolidation tests. Results of settlement are given.

1746. Rockfill Dams: Wishon and Courtright Concrete Face Dams, by Barry Cooke. (PO) Design and construction of two approximately 300-foot high dams are discussed. Changes in design and construction from previous P. G. and E. dams have been made to lower the cost without affecting safety.

1747. Rockfill Dams: The Paradela Concrete Face Dam, by Luis Henreque Gomes Fernandes, Edgard de Oliveira and Nuno de Vasconcelas Porto. (PO) The 361-foot high dam forms part of the hydro-power development of orthern Portugal. The paper discusses the selection of site, type of dam, procedure, design and construction details. Performance data is given.

1748. Rockfill Dams: The Paradela Dam—Foundation Treatment, by Walter J. Weyermann. (PO) Foundation conditions at the site of the Paradela Dam in Portugal and the various problems presented are described. This paper examines the arrangement of grout curtains and presents performance data on seepage control.

1749. Rockfill Dams: Design of Cougar Central Core Dam, by Paul Thurber. (PO) A central-core section was decided for Cougar Dam. The susceptibility of a sloping core of compacted earth to rupture from the type of settlement that would occur helped in making the choice.

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